DEPARTMENT OF AGRICULTURE.

BULLETIN No. 16.

Dairy Feeding as Practiced in Pennsylvania.

BY

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TO THE DIRECTOR OF THE PENNSYLVANIA EXPERIMENT STATION.

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LETTER OF TRANSMITTAL.

AGRICULTURAL EXPERIMENT STATION,
STATE COLLEGE P. O., PA., *October 1st, 1896.*

HON. THOMAS J. EDGE, *Secretary of Agriculture.*

Dear Sir: I have the honor to present herewith a report on Dairy Feeding as Practiced in Pennsylvania, prepared by your direction. In its preparation I have endeavored to arrange its several parts so that it will be of practical use to the dairymen of our State, and have, so far as possible, avoided the use of scientific terms.

Respectfully yours,

ENOS H. HESS,

Assistant in Stock Feeding at The Pennsylvania State College, and Assistant to the Director of the Pennsylvania Experiment Station.

DEPARTMENT OF AGRICULTURE.

HARRISBURG, PA., *October 15th, 1896.*

To the Dairymen of Pennsylvania:

The correspondence of the Department having indicated that the dairymen of our State were exceedingly anxious to obtain definite information in relation to the compounding of properly balanced rations, and further realizing that they were, in many cases, unintentionally wasting stock feed by the use of improper rations, I issued circulars of inquiry to a number of the leading dairymen of the State, asking for their rations just as they were in the habit of feeding them either for milk or butter. A large number of replies were received, but from the fact that a number of them lacked one or more important items, but 105 were taken.

Enos H. Hess, of the Pennsylvania State Experiment Station, was selected to prepare a bulletin upon "Dairy Feeding as Practiced in Pennsylvania," and he was requested to make the necessary calculations, and, after assigning to each ration its nutritive and comparative value, to add such practical information relating to the compounding of rations as might, in his judgment, be best adapted to the wants of our practical dairymen.

The result of Mr. Hess' labors are herewith submitted in the belief that his report will furnish information which, if properly utilized, will enable our dairymen to save a large amount now lost through improperly balanced rations, and, at least to a certain extent, reduce the cost of their product, and possibly, at the same time, increase its quality.

Respectfully yours,

THOS. J. EDGE.

Secretary.

DAIRY FEEDING AS PRACTICED IN PENNSYLVANIA.

INTRODUCTION.

Dairying has for the past few years been one of the most remunerative occupations that the farmers of this State could engage in. Like every other trade or profession, in order that the best results be obtained, it has to be studied in all its phases.

Recent experiments along the line of feeding dairy cattle have developed facts that every person interested in dairying should know. The so-called "Feeding Standards" and "Balanced Rations," if thoroughly understood, are valuable aids to dairymen in their feeding practice, as through them they are enabled to secure the largest possible amount of milk and butter for the least possible cost.

There is a great difference in the practice of the different dairymen of the State, and without a doubt many could improve upon their present practice if they had time to study and fully understand what a well-balanced ration is. Many dairymen, however, do not have the time to give the matter the study it is worthy of. Therefore, in order that they might know what they were feeding from a chemical standpoint, Hon. Thomas J. Edge, Secretary of Agriculture, of Pennsylvania, issued a circular letter in which he requested the dairymen of the State to give him the weights of the different foods they were feeding.

One hundred and five of the rations sent to him were given to the writer to compute the amount of digestible food they contained, the nutritive ratio and cost, and also to make suggestions as to how they might be improved. The object of the work is to reach the dairymen who have, as yet, not studied the scientific side of feeding, and do not know the meaning of many of the terms that are used. The language is, therefore, made as simple as possible, and a glossary is annexed which explains, in a practical way, the meaning of all the scientific terms which are used.

The writer is indebted to Dr. H. P. Armsby, Director of the State Experimental Station, for many valuable suggestions and for kindly correcting some of the original matter.

Valuable material has also been derived from the following publications: Ration Stock Feeding, by Dr. H. P. Armsby; bulletins Nos. 33 and 38, of the Wisconsin Station; bulletin No. 39, of the Hatch

Experiment Station; to the report on the "Study of Rations Fed to Milch Cows in Connecticut," by Charles D. Woods and C. S. Phelps; the report on "Gluten Feeds," by the New Jersey Station; and the Hand-book of Experiment Station Work.

AVERAGE COMPOSITION OF FEEDING STUFFS.

The following table is taken from "Rational Stock Feeding," by H. P. Armsby, with a few additions from the New Jersey report of 1894:

"The figures for the percentage composition are taken, in nearly every case, from the compilation of analyses of American feeding stuffs prepared by Drs. Jenkins and Winton, of the Connecticut station, for the Office of Experiment Stations of the United States Department of Agriculture. The figures for the percentages of digestible matter, contained in the last five columns of the table, have been calculated from the average results of American digestion experiments, as compiled by Director Jordan of the Maine station for the Office of Experiment Stations. In those cases in which no American results were available, the average results of German digestion experiments have been used and in cases where no results were available the digestibility has been estimated from that of other feeding stuffs of similar composition and properties. These latter cases are distinguished by being enclosed in parenthesis in the table.

"Under percentages of digestible matter are given, first, the percentages of digestible protein, carbhydrates and fat; second, in the column headed 'total,' the percentage of total digestible matter reduced to its 'starch equivalent.' A pound of fat has been shown to be about two and one-fourth times as valuable as a pound of carbhydrates for the production of heat or force in the body; consequently the percentage of fat has been multiplied by two and one-one-fourth and the percentages of carbhydrates and protein added to give the figures under the heading of 'total' in the next to the last column of the table. By the nutritive ratio of a feeding stuff is meant the ratio of digestible protein to other digestible matter, the latter having been reduced to its starch equivalent. Thus, the first feeding stuff given in the table contains 1.1 per cent. of digestible protein and 12.3 per cent. of total digestible matter calculated to its starch equivalent. Substracting the 1.1 per cent. of protein, we have left 11.2 per cent. of other digestible matters, consequently the ratio of digestible protein to other digestible matters is 1.1:11.2, or 1:10.2, as given in the last column of the table."

AVERAGE COMPOSITION OF FEEDING STUFFS.—*Continued.*

	Number of Analyses.	Percentage Composition.						Per Cent. of Digestible Matter.				Nutritive ratio.
		Water.	Ash.	Protein.	Crude fibre.	Nitrogen-free extract.	Fat.	Protein.	Carbhydrates.	Fat.	Total.‡	
Soiling Fodder.												
Corn—dent, cut before glazing, ...	54	79.7	1.2	1.7	5.4	11.5	0.5	1.1	11.8	0.4	13.8	1:11.5
Cow pea, ...	10	83.6	1.7	2.4	4.8	7.1	0.4	1.6	7.0	0.2	9.1	1: 4.7
Crimson clover (just heading),† ..	2	89.2	1.2	2.5	1.8	4.9	0.4	1.7	4.4	0.2	6.6	1: 2.9
Crimson clover (full bloom),†	6	81.5	1.5	3.2	5.1	8.1	0.6	2.2	8.2	0.3	11.1	1: 4.1
Oats, ...	5	62.2	2.5	3.4	11.2	19.3	1.4	(2.7)	(22.3)	(1.0)	(27.3)	(1: 9.1)
Orchard grass (in bloom),†	4	73.0	2.0	2.6	8.2	13.3	0.9	1.8	15.5	0.6	18.7	1: 9.1
Pasture grass,†	17	70.3	2.8	4.7	6.5	14.5	1.2	3.5	16.2	0.8	21.5	1: 5.2
Red clover, ...	43	70.8	2.1	4.4	8.1	13.5	1.1	3.0	13.3	0.7	17.9	1: 5.0
Rye, ...	6	82.0	1.6	2.4	4.8	8.5	0.7	1.9	9.8	0.5	12.8	1: 5.7
Soja bean, ...	6	74.8	2.4	3.0	7.3	11.5	1.0	(2.3)	(10.0)	(0.7)	(13.9)	(1: 5.0)
Silage.												
Corn silage—kernels glazing or more mature, ...	14	72.1	1.4	2.1	6.7	16.4	1.3	1.1	15.7	1.1	19.3	1:16.5
Red clover, ...	5	72.0	2.6	4.2	8.4	11.6	1.2	(2.8)	(3.5)	(0.8)	(18.1)	(1: 5.5)
Hay, Straw, Etc.												
Alfalfa hay, ...	21	8.4	7.4	14.3	25.0	42.7	2.2	10.4	40.5	1.1	53.4	1: 4.1
Corn fodder — field cured, ...	35	42.2	2.7	4.5	14.3	34.7	1.6	2.5	33.4	1.2	38.6	1:14.4
Corn stover† — field cured, ...	60	40.1	3.4	3.8	19.7	31.9	1.1	2.0	33.4	0.6	36.8	1:17.4
Clover hay—red, ...	38	15.3	6.2	12.3	24.8	38.1	3.3	6.4	34.9	1.6	44.9	1: 6.0
Hungarian grass hay,†	12	7.7	6.0	7.5	27.7	49.0	2.1	4.2	46.7	1.0	53.2	1:11.4
Mixed meadow grass hay,†	31	16.0	4.6	6.4	29.9	41.0	2.1	3.6	42.9	1.0	48.8	1:12.6
Mixed hay, ...	....	14.3	5.3	9.1	26.9	41.5	2.9	4.7	39.3	1.5	47.4	1: 9.1
Oat straw, ...	12	9.2	5.1	4.0	37.0	42.4	2.3	1.4	43.9	0.9	47.3	1:32.8
Orchard grass hay,	10	9.9	6.0	8.1	32.4	41.0	2.6	4.8	42.0	1.4	50.0	1: 9.4
Red top hay, ...	9	8.9	5.2	7.9	28.6	47.5	1.9	4.8	46.9	1.0	54.0	1:10.3

Average Composition of Feeding Stuffs.—*Continued.*

	Number of Analyses.	Percentage Composition.						Per Cent. of Digestible Matter.				Nutritive ratio.
		Water.	Ash.	Protein.	Crude fibre.	Nitrogen-free extract.	Fat.	Protein.	Carbhydrates.	Fat.	Total.‡	
Rye straw, ...	7	7.1	3.2	3.0	38.9	46.6	1.2	0.6	40.6	0.4	43.1	1:69.2
Timothy hay, ...	68	13.2	4.4	5.9	29.0	45.0	2.5	2.9	43.7	1.4	49.8	1:16.2
Wheat straw, ...	7	9.6	4.2	3.4	38.1	43.4	1.3	0.6	38.2	0.5	39.9	1:65.5
Roots and Tubers.												
Carrots, ...	8	88.6	1.0	1.1	1.3	7.6	0.4	(0.9)	(8.2)	(0.3)	(9.8)	(1: 9.9)
Mangel wurzels, ..	9	90.9	1.1	1.4	0.9	5.5	0.2	1.1	5.4	....	6.5	1: 4.9
Potatoes, ...	12	78.9	1.0	2.1	0.6	17.3	0.1	0.9	15.7	....	16.6	1:17.4
Rutabagas, ...	4	88.6	1.2	1.2	1.3	7.5	0.2	1.0	8.1	0.2	9.5	1: 8.5
Sugar beets, ...	19	86.5	0.9	1.8	0.9	9.8	0.1	1.6	10.7	0.1	12.5	1: 6.8
Turnips, ...	3	90.5	0.8	1.1	1.2	6.2	0.2	1.0	7.2	0.2	8.7	1: 7.7
Grain												
Barley, ...	10	10.9	2.4	12.4	2.7	69.8	1.8	8.7	65.6	1.6	77.9	1: 8.0
Buckwheat, ...	8	12.6	2.0	10.0	8.7	64.5	2.2	(7.8)	(50.7)	(1.8)	(62.6)	(1: 7.0
Corn—dent, ...	86	10.6	1.5	10.3	2.2	70.4	5.0	6.2	64.8	4.6	81.4	1:12.1
Corn—flint, ...	68	11.3	1.4	10.5	1.7	70.1	5.0	6.3	54.5	4.6	81.2	1:11.9
Corn—Sweet, ...	26	8.8	1.9	11.6	2.8	66.8	8.1	7.0	61.5	7.5	85.4	1:11.2
Oats, ...	30	11.0	3.0	11.8	9.5	59.7	5.0	9.2	47.3	2.6	62.4	1: 5.8
Peas, ...	....	14.4	2.7	22.6	5.4	53.0	1.9	18.8	51.2	1.0	72.3	1: 2.8
Rye, ...	6	11.6	1.9	10.6	1.7	72.5	1.7	(6.4)	(66.7)	(1.6)	(76.7)	(1:11.0)
Sorgum seed, ...	10	12.7	2.1	9.0	2.6	70.0	3.6	(5.4)	(64.4)	(3.3)	(72.2)	(1:13.3)
Wheat—spring, ...	13	10.4	1.9	12.5	1.8	71.2	2.2	(7.5)	(65.5)	(2.0)	(77.5)	(1: 9.3)
Wheat—winter, ...	262	10.5	1.8	11.8	1.8	72.0	2.1	(7.1)	(66.2)	(1.9)	(77.6)	(1: 9.9)
Wheat — winter raised in Pennsylvania, ...	41	10.7	1.6	11.8	1.7	72.2	2.0	(7.1)	(66.4)	(1.8)	(77.6)	1: 9.9
Mill Products.												
Barley meal, ...	3	11.9	2.6	10.5	6.5	66.3	2.2	7.4	64.3	2.0	76.2	1: 9.3
Corn meal, ...	77	15.0	1.4	9.2	1.9	68.7	3.8	5.5	63.2	3.5	76.6	1:12.9
Corn-and-cob meal,	7	15.1	1.5	8.5	6.6	64.8	3.5	4.4	60.0	2.9	70.9	1:15.1
Peal meal, ...	2	10.5	2.6	20.2	14.4	51.1	1.2	16.8	51.7	0.6	69.9	1: 3.2
Rye bran, ...	7	11.6	3.6	14.7	3.5	63.8	2.8	(11.5)	(44.3)	(2.0)	(60.3)	(1: 4.2)
Wheat bran, ...	88	11.9	5.8	15.4	9.0	53.9	4.0	12.0	38.9	2.9	57.4	1: 3.8
Wheat middlings, ..	32	12.1	3.3	15.6	4.6	60.4	4.0	12.8	53.2	3.4	73.7	1: 4.8
Wheat shorts, ...	12	11.8	4.6	14.9	7.4	56.8	4.5	12.2	50.0	3.8	70.8	1: 4.8

AVERAGE COMPOSITION OF FEEDING STUFFS.—*Continued.*

	Number of Analyses.	Percentage Composition.						Per Cent. of Digestible Matter.				Nutritive ratio.
		Water.	Ash.	Protein.	Crude fibre.	Nitrogen-free extract.	Fat.	Protein.	Carbhydrates.	Fat.	Total.‡	
By-Products and Waste Material.												
Apple pomace, ...	7	76.7	0.5	1.4	3.9	16.2	1.3	(1.1)	(16.4)	....	(17.5)	(1:14.9)
Brewers' grains—dried, ...	3	8.2	3.6	19.9	11.0	51.7	5.6	15.7	36.3	5.1	63.5	1: 3.0
Brewers' grains—wet, ...	15	75.7	1.0	5.4	3.8	12.5	1.6	4.3	9.4	1.5	17.1	1: 3.0
Buckwheat middlings, ...	3	13.2	4.8	28.9	4.0	42.0	7.1	(23.7)	(37.0)	(6.0)	(74.2)	(1: 2.1)
Ceraline food,†	3	9.6	2.6	10.6	6.8	62.3	8.1	9.0	53.4	6.6	77.3	1: 7.8
Corn oil meal,†	3	9.0	2.4	24.8	6.7	43.6	13.5	21.1	38.2	10.9	83.8	1: 3.1
Corn cobs, ...	18	10.7	1.4	2.4	30.1	54.9	0.5	0.4	52.5	0.3	53.6	1:33.0
Cotton seed hulls, .	4	10.4	2.6	4.0	44.4	36.6	2.0	0.4	31.5	1.5	35.3	1:87.3
Cotton seed meal, .	35	8.2	7.2	42.3	5.6	23.6	13.1	37.2	15.1	12.7	80.9	1: 1.2
Gluten meal, ...	32	9.6	0.7	29.4	1.6	52.4	6.3	25.6	47.7	5.5	85.7	1: 2.4
Buffalo gluten meal,	1	7.8	1.0	21.8	6.7	52.7	10.0	18.5	45.6	8.1	82.3	1: 3.4
Chicago gluten meal, ...	1	11.1	1.2	35.1	0.7	45.0	6.9	30.5	41.0	6.1	85.2	1: 1.8
Cream gluten meal,	1	8.1	1.2	38.4	3.3	32.8	16.2	33.4	29.8	14.3	95.4	1: 1.9
Grano gluten feed,†	3	6.0	2.7	31.0	11.4	34.7	14.2	26.4	33.0	11.5	85.3	1: 2.3
Germ meal,†	1	29.6	11.1	21.7	2.9	45.8	29.6	(13.0)	(43.8)	(26.7)	(116.9)	....
Linseed meal—new process, ...	14	10.1	5.8	33.2	9.5	38.4	3.0	28.9	38.8	2.7	73.8	1: 1.6
Linseed meal—old process, ...	21	9.2	5.7	32.9	8.9	35.4	7.9	29.3	32.7	7.0	77.8	1: 1.7
Malt sprouts, ...	4	10.2	5.7	23.2	10.7	48.5	1.7	18.6	36.5	1.7	58.9	1: 2.2
Dairy Products.												
Buttermilk, ...	24	91.8	0.8	2.8	......	4.3	0.3	2.8	4.3	0.3	7.8	1: 1.8
Milk, ...	....	87 3	0.7	3.1	......	5.1	3.8	3.1	5.1	3.8	16.8	1: 4.4
Skim-milk, ...	303	90.5	0.8	3.5	......	4.8	0.4	3.5	4.8	0.4	9.2	1: 1.6
Whey, ...	....	93.0	0.8	0.8	......	5.0	0.4	0.8	5.0	0.4	6.7	1: 7.4

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‡ The fat reduced to its starch equivalent by multiplying by 2.25.

† Taken from the New Jersey report for 1894.

FERTILIZER CONSTITUENTS OF AMERICAN FEEDING STUFFS AND MANURIAL VALUE PER TON.

In commercial fertilizers there are only three ingredients which are assumed to have any practical value, namely: Nitrogen, phosphoric acid and potash. The foods used in feeding dairy cattle contain more or less of these three ingredients, and, therefore, have a fertilizing value equal to the amount of nitrogen, phosphoric acid and potash they contain. The nitrogen is valued at twelve cents per pound, the phosphoric acid at four cents and potash at five cents per pound. No allowance is made for the value of the humus, which has some value, but as to how much it has, will have to be left to the judgment of the reader, for as yet it has not been scentifically determined.

	Pounds in 100 pounds.			Manural value in dollars per ton.			
	Nitrogen.	Phosphoric acid.	Potash.	Nitrogen.	Phosphoric acid.	Potash.	Total.
Soiling Fodder.	lbs.	lbs.	lbs.				
Corn—Dent, cut before glazing,	0.41	0.15	0.33	$0.984	$0.120	$0.33	$1.43
Cow pea,	0.27	0.10	0.31	.648	.080	.31	1.01
Crimson clover (just heading),†	0.40	0.12	0.34	.960	.096	.34	1.40
Crimson clover (full bloom),†	0.51	0.12	0.35	1.224	.096	.35	1.67
Orchard grass (in bloom),	0.43	0.16	0.76	1.032	.128	.76	1.92
Pasture grass,†	0.75	0.19	0.60	1.800	.152	.60	2.55
Red clover,	0.53	0.13	0.46	1.272	.104	.46	1.84
Rye,	0.33	0.15	0.73	.792	1.20	.73	1.64
Soja bean,	0.29	0.15	0.53	.696	.120	.53	1.35
Silage.							
Corn silage—Average of all analyses,	0.28	0.11	0.37	.672	.088	.37	1.13
Red clover,	0.53	0.13	0.46	1.272	.104	.46	1.84
Hay, Straw, Etc.							
Alfalfa hay,	2.19	0.51	1.68	5.256	.408	1.68	7.34
Corn fodder—field cured,	1.76	0.54	0.89	4.225	.432	.89	5.55
Corn stover—field cured,	1.04	0.29	1.40	2.496	.232	1.40	4.13
Clover hay—red,	2.07	0.38	2.20	4.968	.304	2.20	7.47
Hungarian grass hay,	1.20	0.35	1.30	2.880	.280	1.30	4.46
Mixed meadow grass hay,†	1.02	0.26	1.48	2.448	.208	1.48	4.14
Mixed hay,	1.67	0.46	1.55	4.009	.368	1.55	5.93
Oat straw,	0.62	0.20	1.24	1.488	.160	1.24	2.89

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† Taken from the New Jersey report for 1894

FERTILIZING CONSTITUENTS OF AMERICAN FEEDING STUFFS AND MANURAL VALUE PER TON.—*Continued.*

	Pounds in 100 pounds.			Manural value in dollars per ton.			
	Nitrogen.	Phosphoric acid.	Potash.	Nitrogen.	Phosphoric acid.	Potash.	Total.
Hay, Straw, Etc.	lbs.	lbs.	lbs.				
Orchard grass hay,	1.31	0.[illegible]1	1.88	$3.144	$0.323	$1.88	$5.35
Red top hay,	1.15	0.36	1.02	2.760	.288	7.02	4.07
Rye straw,	0.46	0.28	0.79	1.104	.224	.79	2.12
Timothy hay,	1.26	0.53	0.90	3.024	.424	.90	4.35
Wheat straw,	0.59	0.12	0.51	1.416	.096	.51	2.02
Wheat chaff,	0.79	0.70	0.42	1.896	.560	.42	2.88
Roots and Tubers.							
Carrots,	0.15	0.09	0.51	.360	.072	.51	.94
Mangel wurzels,	0.19	0.09	0.38	.456	.072	.38	.91
Potatoes,	0.21	0.07	0.29	.504	.056	.29	.85
Rutabagas,	0.19	0.12	0.49	.456	.096	.49	1.04
Sugar beets,	0.22	0.10	0.48	.528	.080	.48	1.09
Turnips,	0.18	0.10	0.39	.432	.080	.39	.90
Grain.							
Barley,	1.51	0.79	0.48	3.625	.632	.48	4.74
Buckwheat,	1.44	0.44	0.21	3.456	.352	.21	4.02
Corn—dent,†	1.65	0.70	0.40	3.961	.560	.40	4.92
Corn—flint,†	1.68	0.70	0.40	4.033	.560	.40	4.99
Corn—sweet,†	1.82	0.72	0.41	4.369	.576	.41	5.36
Oats,	2.06	0.82	0.62	4.945	.656	.62	6.22
Peas,	3.08	0.82	0.99	7.393	.656	.99	9.04
Rye,	1.76	0.82	0.54	4.225	.656	.54	5.42
Sorgum seed,	1.48	0.81	0.42	3.553	.648	.42	4.62
Wheat—spring,	2.36	0.70	0.39	5.665	.560	.39	6.62
Wheat—winter,	2.36	0.89	0.61	5.665	.712	.61	6.99
Mill Products.							
Barley meal,	1.55	0.66	0.34	3.720	.528	.34	4.59
Buckwheat middlings,	4.62	1.73	1.56	11.088	1.384	1.560	14.032
Corn meal,	1.58	0.63	0.40	3.792	.504	.40	4.70
Corn-and-cob meal,	1.41	0.57	0.47	3.384	.456	.47	4.31
Pea meal,	3.08	0.82	0.99	7.392	.656	.99	9.04
Rye bran,	2.32	2.28	1.40	5.568	1.824	1.40	8.79
Wheat bran,	2.67	2.89	1.61	6.408	2,312	1.61	10.33
Wheat middlings,	2.63	0.95	0.63	6.312	.760	.63	7.70
Wheat shorts,†	2.42	1.38	0.65	5.808	1.104	.65	7.56

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† Taken from the New Jersey report for 1894.

FERTILIZING CONSTITUENTS OF AMERICAN FEEDING STUFFS AND MANURAL VALUE PER TON.—*Continued.*

	Pounds in 100 pounds.			Manural value in dollars per ton.			
	Nitrogen.	Phosphoric acid.	Potash.	Nitrogen.	Phosphoric acid.	Potash.	Total.
By-Products and Waste Material.	lbs.	lbs.	lbs.				
Apple pomace,	0.23	0.02	0.13	$0.552	$0.016	$0.13	$0.70
Brewers' grains—dried,	3.05	1.26	1.55	7.320	1.008	1.55	9.88
Brewers' grains—wet,	0.89	0.31	0.05	2.136	.248	.05	2.43
Cerealine feed,†	1.69	1.25	0.67	4.056	1.000	.67	5.73
Corn oil meal,†	3.96	1.45	0.17	9.504	1.160	.17	10.83
Corn cobs,	0.50	0.06	0.60	1.200	.048	.60	1.85
Cotton seed hulls,	0.75	0.18	1.08	1.800	.144	1.08	3.02
Cotton seed meal,	6.64	2.68	1.79	15.936	2.144	1.79	19.87
Gluten meal,	5.03	0.33	0.05	12.072	.264	.05	12.39
Buffalo gluten feed,†	3.44	0.38	0.07	8.256	.304	.07	8.63
Chicago gluten meal,†	5.52	0.29	0.05	13.248	.232	.05	13.53
Grano gluten feed,†	4.96	0.66	0.20	11.904	.528	.20	12.63
Germ meal,†	3.48	6.16	2.91	8.352	4.928	2.91	16.19
Linseed meal—new process,	5.78	1.83	1.39	13.872	1.464	1.39	16.73
Linseed meal—old process,	5.43	1.66	1.37	13.032	1.328	1.37	15.73
Malt sprouts,	3.55	1.43	1.63	8.520	1.144	1.63	11.29
Dairy Products.							
Butter,	0.12	0.04	0.04	.288	.032	.04	.36
Buttermilk,	0.48	0.17	0.16	1.152	.136	.16	1.45
Cheese,	3.93	0.60	0.12	9.432	.480	.12	10.03
Cream,	0.40	0.15	0.13	.960	.120	.13	1.21
Milk,	0.53	0.19	0.18	1.272	.152	.18	1.60
Skim-milk,	0.56	0.20	0.19	1.344	.160	.19	1.69
Whey,	0.15	0.14	0.18	.360	.112	.18	.65

† Taken from New Jersey report for 1894.

The above table shows a very wide range in the fertilizing value of the different dairy foods and products. The highest value per ton is $19.87 for cotton seed meal and the lowest is 36 cents for butter. The importance of the fertilizing value of foods is, therefore, clearly seen and must be carefully studied if the maximum results are to be obtained.

COMPARISON OF FEEDING STANDARDS.

In the following table is given the German standard ration for cows weighing 1,000 pounds, which was prepared twenty-five or more years ago, by Professor Wolff, an eminent German chemist and experimenter, and the average of rations fed in different parts of the United States:

Ration. †	Total Dry Matter.	Per Cent. of Digestible Matter.				Total Digestible Matter when the fat is multiplied by 2.25.	Nutritive Ratio.
		Protein.	Carbhydrates.	Fat.	Total.		
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
Wolff's (German) standard,	24.0	2.50	12.50	.40	15.40	16.00	1:5.4
Average of 128 American rations compiled by the Wisconsin Experiment Station,	24.5	2.15	13.27	.74	16.16	17.09	1.6.9
Average of 16 rations as fed in Connecticut in 1892-93,	26.4	2.48	14.09	.94	17.51	18.69	1:6.5
Average of 25 rations as fed in Connecticut in 1892-94,	26.8	2.52	13.92	.91	17.35	18.49	1:6.3
Average of 105 rations as fed in Pennsylvania in 1895-96,	24.4	2.06	12.81	.73	15.60	16.51	1:7.5

† For explanation of scientific term see Glossary.

When taken as a whole, the above standards agree fairly well, yet none of them can be said to be scientifically right, as they only represent the practice of the best dairymen. There will have to be made a large number of carefully conducted experiments along this line before we can say that the standard is scientifically right. Of the work that has been done it would indicate that the nutritive ratio in these standards is too wide, especially the one for Pennsylvania. That is to say, they do not contain enough protein or the part of the food that goes to form muscle and milk.

It is a well recognized fact that there is nothing to equal June grass for the production of milk and butter. The nutritive ratio of pasture grass is 1 to 5.2, or, in other words, it contains one pound of protein or milk forming food to 5.2 pounds of carbhydrates and fat or heat and fat forming foods. By this it will be seen that the above rations would tend to fatten cows instead of have them produce milk. In an experiment made by the Pennsylvania Experiment Station there was an increase of 11.1 per cent. in the per cent. of butter fat the milk contained when the nutritive ratio was narrowed from 1:6.6 to 1:4.2. (See annual report for 1895, pp. 56-74). Wolff's German standard comes the nearest to what the writer thinks is right, with the exception of the fat, as the feeds that our dairymen have at their command contains more fat than the German foods. If less carbhydrates were fed, the results would be practically the same.

VALUE OF STANDARDS.

The standards are very valuable to dairymen if properly used, but they are not to be followed blindly. They should only be used as guides by dairymen in compounding rations, as there are local conditions which enter into the matter that cannot be altered, and the only thing to do is to come as close to the standard as possible. In this, as in almost every other occupation, there is needed a good supply of common sense.

A farmer in Pennsylvania may write a book and tell how he manages his farm, and although he is very successful, his methods would, in many cases, not do for a farmer in North Carolina. There are, of course, some things which would do for both sections. The North Carolina farmer must, therefore, use his judgment as to how much of the Pennsylvania farmer's practice will be adapted to his section. He can find it out by trying it, but it costs too much to try every thing that you hear some one say is good.

The majority of the dairymen of this State raise, practically, all of the feed they use on their own farms. This is a very good principle, but it can be carried too far, because most of the crops that the dairymen of the State raise do not contain enough protein. It is, therefore, often economical to sell some of our crops and buy some by-product such as bran, gluten meal, linseed meal or cotton seed meal. In order to do this properly we should know the chemical analysis or fertilizing value of the things we buy and sell. Our aim should be to sell the crops that contain the smallest amount of nitrogen, phosphoric acid and potash, or the valuable ingredients of fertilizers, and buy those that contain the most.

The table showing the fertilizing value of the different foods should be carefully studied, for by exchanging foods in this way we can often get our fertilizers very cheap.

In compounding a ration the physiological effect of the different foods should also be considered. Information on this matter can be found in the glossary. The price of the different materials at a person's command is also a very important factor to be considered, and the ration will need to be changed from year to year as the prices of the different foods change. The standards are supposed to be right for a cow weighing 1,000 pounds, and will have to be varied as the weight of the cows vary.

Probably the most important part to be considered in determining how much to feed is the cow herself. Every dairyman knows that two cows weighing the same may differ widely in their power to consume and assimilate food, and, therefore, in order to secure the best results, each cow's consuming and assimilating power must be carefully studied. A cow is capable of assimilating a certain amount of food, and when she consumes more than this, it simply passes off as dung and does not increase the flow of milk. Overfeeding is fully as bad as underfeeding, and should be carefully guarded against.

PRINCIPLES OF SCIENTIFIC FEEDING.

"The animal body is made up mainly of four classes of substances: water, ash or mineral matter, nitrogenous matter and fat. Water constitutes from 40 to 60 per cent. of the body and is an essential part. From 2 to 5 per cent. of the weight of the body is ash. This occurs mainly in the bones. The fat varies greatly with the condition of the animal, but seldom falls below 6 per cent., or rises above 30 per cent. The nitrogenous materials or protein include all of the materials containing nitrogen; all those outside this group are free from nitrogen, or non-nitrogenous. The nitrogen referred to here is the same as that mentioned in connection with fertilizers, and is the element which constitutes about four-fifths of the atmosphere. It occurs in plants and animals in various compounds grouped under the general name of protein. Lean meat, white of the egg and casein or milk (curd), are familiar forms of protein. The albuminoids are a class of compounds included under protein. Protein is undoubtedly of first importance in the animal economy. The flesh, skin, bones, muscles, internal organs, brain and nerves, in short, all of the working machinery of the body, is composed very largely of nitrogenous substances (protein).

"The proportion in which these four different classes of substances occur depends upon the age of the animal, treatment, purposes for which it is kept, etc. The substances of the body are continually breaking down and being consumed. All work, movement, breathing, digestion, etc., result in a breaking down of the tissue. To keep the animal in a healthy condition there must be a constant supply of new material. If this is lacking or insufficient, hunger and finally death results. To keep up this supply is one of the chief functions of foods, but in addition to this, the food maintains the heat of the body, and at the same time furnishes the force or energy which enables the animal to move the muscles and do work and also to perform the functions of the body.

"If in addition to repairing the waste of the system and furnishing it with heat and energy, growth is to be made, as in the case of immature animals, or milk secreted, an additional supply of food will be required. To supply food in the right proportions to meet the requirements of the animal without a waste of food nutrients, constitutes scientific feeding. It is by carefully studying the composition of feeding stuffs, the proportion in which they are digested by different animals and under different conditions, and the requirement of animals for the various food nutrients when at rest, at work, giving milk, or producing wool, mutton, beef, pork, etc., that the principles of scientific feeding have been worked out."

In compounding a ration for a dairy cow with the common winter foods, there should be about one pound of grain and two pounds of coarse fodder fed per day for every hundred pounds of live weight. A cow weighing 1,000 pounds would need ten pounds of grain and twenty pounds of coarse fodder. This proportion will have to be varied at times to suit the local conditions; for when hay and corn stover is scarce and dear, it might be found advisable to feed as many pounds of grain as coarse fodder; or when very cheap in comparison to the grain, to feed three times as much coarse fodder as grain. Disregarding the price of the materials 1 to 2 is about the proper proportion for grain and coarse fodder.

INDIVIDUALITY OF COWS.

Every one who has had any practical experience in feeding dairy cattle knows that there is a very large difference in different animals as to their ability to consume and assimilate food. The standards are very useful as guides, but he who would make the most of dairying must study the individuality of each cow and learn to know what she needs, and then feed her accordingly. No one can make a success of the business who feeds his cows in a haphazard manner. The same person should feed the cows every meal and at a fixed time. The time at which they are fed should never vary more than ten or fifteen minutes.

HOW TO COMPUTE A RATION.

The method of computing a ration is very simple if one knows how to do it, but the "know how" is often very difficult to learn. It will be explained in as simple terms as possible in order that all who read carefully may learn how.

We will take a ration that contains 45 pounds ensilage, 5 pounds clover hay and 6 pounds buckwheat middlings. By referring to the table showing the composition of feeding stuffs, we find that these three foods contain the following amounts of digestible matter:

	Total Dry Matter	Present Digestible Matter.			Nutritive Ratio.
		Protein.	Carbhy-drates.	Fat.	
Ensilage—kernels glazing or more matured,	27.9	1.1	15.7	1.1	1:16.5
Clover hay—red,	84.7	6.4	34.9	1.6	1: 6.0
Buckwheat middlings,	86.8	(23.7)	(37.0)	(6.0)	(1: 2.1)

There is 72.1 per cent. of water in ensilage; to determine the amount of dry matter we subtract the amount of water it contains from 100, which leaves us 27.9 per cent. of dry matter. (See table). The dry matter is obtained in this way for clover hay and buckwheat middlings or any other food you may wish to compute the analysis of.

The figures in the above table gives the amount of digestible food in one pound of the different materials. In 45 pounds of ensilage there would be 45 times as much; in 5 pounds of clover hay there would be 5 times as much; and in 6 pounds of buckwheat middlings there would be 6 times as much digestible food as is given in the table. Multiplying these figures by 45, 5 and 6 respectively, we get the following:

	Fresh Weight.	Total Dry Matter.	Protein.	Carbhy-drates.	Fat.	Total Digestible Matter.	Nutritive Ratio.
	lbs.	lbs.	lbs.	lbs.	lbs.		
Ensilage,	45	12.56	.50	7.08	.50	8.08	....
Clover hay,	5	4.24	.32	1.75	.08	2.15	....
Buckwheat middlings,	6	5.21	1.42	2.22	.36	4.00	....
Total,	....	22.01	2.24	11.05	.94	14.23	1:5.9
Reduced for a cow weighing 1,000 pounds,	....	22.69	2.31	11.39	.97	14.23	1:5.9
Wolff's German standard,	....	24.00	2.50	12.50	.40	15.40	1:5.4

The cows receiving this ration are assumed to weigh 970 pounds. Other things being equal, the heavier the cow the more food she will need. The standard rations give the amount of food required for a cow weighing 1,000 pounds. Therefore, in order to compare this ration with the standard it has to be reduced by dividing by .970. This quotient gives the amount of digestible food that would be required for a cow weighing 1,000 pounds on the same basis. It will be seen that it does not contain as much total dry matter, protein, carbhydrates and total digestible matter as the German standard; but more fat and the nutritive ratio is wider.

HOW TO CALCULATE THE NUTRITIVE RATIO AND TOTAL DIGESTIBLE MATTER.

If we burn a pound of coal we know that there is a certain amount of heat produced. If this heat be applied to water there will a given quantity of the water be converted into steam. Compress this steam and we get power by which we can run a threshing machine or lift a weight.

If we burn protein, carbhydrates or fat we will also get a certain amount of power if the heat is applied to water. We will assume that the burning of one pound of protein will produce enough power to lift one pound one foot from the ground. The carbhydrates have about the same power; but the power produced by burning one pound of fat is two and one-fourth times as great. That is to say, if one pound of fat were burnt it would lift one pound two and one-fourth feet from the ground or two and one-fourth pounds one foot from the ground. In order to have the protein carbhydrates and fat on the same basis, we multiply the amount of fat by two and one-fourth, add this product to the amount of carbhydrates and divide the sum obtained, by the protein. The quotient will be the ratio. In the above ration there is .94 pound of fat. This multiplied by 2¼ equals 2.12 pounds; add to this amount the 11.05 pounds of carbhydrates and we have 13.17 pounds. Divide this amount by 2.24 (the amount of protein) and we get a quotient of 5.9, which equals the ratio of 1:5.9. That is to say, there is one pound of protein or milk and muscle forming food to 5.9 pounds of carbhydrates and fat or heat and fat forming foods.

AVERAGE PENNSYLVANIA PRICES FOR FEEDING STUFFS.

In a subjoined table is given as near as possible the average selling price of the different feeding stuffs for the past ten years. It was next to impossible to get figures for so long a time on some of the feeds. In these cases the present prices were taken. The price of feeds is very low this year, so that for the present these prices would be too high and would have to be reduced. The cost of all the rations are based on the figures given in this table; in the case of hay, corn stover and other products of the farm the prices given are somewhat below the market price and in the case of the by-products that have to be bought the prices given are slightly higher than the market price. This was done in order to make allowance for the expense of hauling to or from the farm:

	Price per ton.	Price per pound.
Barley meal,	$20 00	1.0
Brewers' grain (dry),	14 00	0.7
Buckwheat meal,	20 00	1.0
Buckwheat middlings,	18 00	.9
Cerealine food,	12 00	.6
Clover hay,	8 00	.4
Corn-and-cob meal,	15 00	.75
Corn meal,	20 00	1.0
Corn silage,	2 00	.1
Corn stover,	5 00	.25
Cotton seed meal,	26 00	1.3
Germ meal,	17 00	.85
Gluten meal,	18 00	.9
Gluten meal (Buffalo),	18 00	.9
Gluten meal (Atlas),	18 00	.9
Green rye,	2 00	.1
Hominy meal,	14 00	.7
Linseed meal,	24 00	1.2
Malt sprouts,	22 00	1.1
Mangolds,	2 00	.1
Meadow hay,	10 00	.5
Millet hay,	7 00	.35
Mixed hay,	9 00	.45
Oat meal,	22 00	1.1
Oat straw,	5 00	.25
Potatoes,	5 00	.25
Rutabagas,	3 00	.15
Skimmed milk,	3 60	.18

	Price per ton.	Price per pound.
Wheat bran,	$18 00	.9
Wheat chaff,	5 00	.25
Wheat middlings,	19 00	.95
Wheat shorts,	19 00	.95
Wheat straw,	5 00	.25

RATIONS FED BY PENNSYLVANIA DAIRYMEN.

1.—The cows receiving this ration are large Holsteins, weighing from 1,000 to 1,400 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.*		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage,	50	13.95	.55	7.85	.55	9.65	5.0	....
Clover hay,	8	6.78	.51	2.79	.13	3.59	3.2	....
Wheat bran,	6	5.29	.72	2.33	.17	3.44	5.4	....
Corn meal,	2	1.70	.11	1.23	.07	1.53	2.0	....
Total,	....	27.72	1.89	14 23	.92	18.21	15.6	1:8.6
Ration reduced to 1,000 pound standard,†	....	21.32	1.45	10.95	.71	14.01	12.0	....

* The fat reduced to starch equivalent by multiplying by 2.25.

†See how to compute a ration, page 17.

This ration for a 1,300 pound cow does not contain enough grain, and the nutritive ratio is too wide. Adding two or three pounds cotton seed meal would improve it.

2.—This ration is fed to standard bred cows, weighing 950 pounds, for the production of milk for the city market. One-half is fed at five a. m. and the remainder at five p. m.:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	30	8.37	.33	4.71	.33	5.79	3.0	....
Wheat bran, ...	7	6.17	.84	2.72	.20	4.02	6.3	....
Brewers' grain—wet, ...	10	2.43	.43	.94	.15	1.71	2.5	....
Corn meal, ...	3	2.55	.17	1.90	.11	2.30	3.0	....
Mixed hay, ...	10	3.58	.47	3.93	.15	4.74	4.5	....
Total, ...	....	28.10	2.24	14.20	.94	18.56	19.3	1:7.3
Ration reduced to 1,000 pound standard, ...	....	29.58	2.36	14.95	.99	19.54	20.3	....

This is a fairly well-balanced ration, but is too heavy. Two or 3 pounds less of wheat bran, 1 or 2 of corn meal and 2 of mixed hay would improve it; 1 or 2 pounds of cotton seed meal might be substituted for an equal weight of bran.

3.—This ration is fed to cows weighing 850 pounds, for the production of butter:

	Fresh weight	Dry matter.	Digestible.				Cost of ration.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	20	17.16	.94	7.86	.30	9.48	9.0	....
Oat straw, ...	4	3.63	.06	1.76	.04	1.89	1.0	....
Corn meal, ...	5	4.25	.28	3.16	.18	3.83	5.0	....
Oat meal, ...	3	2.67	.23	1.42	.08	1.87	3.3	....
Wheat chaff, ...	3	2.71	.09	.70	.02	.84	0.8	....
Total, ...	....	30.42	1.65	14.90	.62	17.91	19.1	1:9.9
Ration reduced to 1,000 pound standard, ...	....	35.79	1.94	17.53	.73	21.07	22.5	....

There was probably a mistake made in the weight of this ration, as from our experience I do not believe that cows weighing 850 pounds would eat 27 pounds of coarse fodder in connection with 8 pounds of grain. The ration is also too expensive to be practical and does not contain enough protein. With these feeds it would be impossible to compound an economical ration. Ten pounds mixed hay, 4 pounds oat straw, 3 pounds wheat chaff, 4 pounds corn meal, 2 pounds wheat bran or middlings, and 2 pounds linseed meal would improve it.

4.—The cows receiving this ration weigh 1,000 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	20	17.16	.94	7.86	.30	9.48	9.0	....
Corn-and-cob meal, ...	6	5.09	.26	3.60	.17	4.25	4.5	....
Wheat bran, ...	6	5.29	.72	2.33	.17	3.44	5.4	....
Gluten meal, ...	2	1.81	.51	.95	.11	1.71	1.8	....
Total, ...	....	29.35	2.43	14.74	.75	18.88	20.7	1:6.8

This ration is fairly well-balanced, but is rather heavy. One or two pounds less of hay, corn-and-cob meal and bran would probably give more economical results.

5.—The cows to which this ration was fed weigh about 970 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of ration.	Nutritive ratio.
			Protein	Carbhy-	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	45	12.56	.50	7.07	.50	8.69	4.5	....
Clover hay, ...	5	4.24	.32	1.75	.08	2.25	2.0	....
Buckwheat middlings, .	6	5.21	1.42	2.22	.36	4.45	5.4	....
Total, ...	....	22.01	2.24	11.04	.94	15.39	11.9	1:5.9
Ration reduced to 1,000 pound standard, ...	....	22.69	2.31	11.38	.97	15.87	12.3	....

This is a very cheap and narrow ration, and will without a doubt give very satisfactory results. We have been feeding buckwheat middlings the past year, and are well pleased with the results.

6.—The cows receiving this ration weigh 970-975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of ration.	Nutritive ratio.
			Protein	Carbhydrates.	Fat	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	40	11.16	.44	6.23	.44	7.72	4.0	....
Clover hay, ...	5	4.24	.32	1.75	.08	2.25	2.0	....
Wheat middlings, ...	6	5.27	.77	3.19	.20	4.42	5.7	....
Total, ...	....	20.67	1.53	11.22	.72	14.39	11.7	1:8.4
Ration reduced to 1,000 pound standard, ...	....	21.20	1.57	11.51	.74	14.76	12.0	....

This is a cheap ration, but should prefer to have the nutritive ratio somewhat narrower, that is to say, have more protein or the milk forming food in it. The previous ration should produce more milk and of a better quality than this one. Two pounds of cotton seed meal added and half the wheat middlings substituted for an equal weight of buckwheat middlings would improve it.

7.—This ration is fed to cows weighing 900 pounds, for the production of butter:

	Fresh weight	Dry matter.	Digestible.				Cost of ration.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	50	13.95	.55	7.85	.55	9.65	5.0	....
Wheat bran, ...	7	6.17	.84	2.72	.20	4.02	6.3	....
Cotton seed meal, ...	1	.92	.37	.15	.13	.81	1.3	....
Clover hay, ...	2	1.69	.13	.70	.03	.90	.8	....
Total, ...	....	22.73	1.89	11.42	.91	15.38	13.4	1 :7.1
Ration reduced to 1,000 pound standard, ...	....	25.26	2.10	12.69	1.01	17.09	14.9	....

This ration is fairly well-balanced, but should be afraid to feed so much ensilage for any length of time. Ten or 15 pounds less ensilage, 6 pounds more clover hay and 1 pound more cotton seed meal would probably give better results.

8.—The cows receiving this ration weigh about 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.	Cts.	
Corn stover, ...	8½	5.09	.17	2.84	.05	3.13	2.1	....
Wheat bran, ...	3	2.64	.36	1.17	.09	1.72	1.8	....
Linseed meal, ...	2	1.82	.59	.65	.14	1.56	2.4	....
Corn meal, ...	1½	1.28	.08	.95	.05	1.15	1.5	....
Oat meal, ...	1	.89	.09	.47	.03	.62	1.1	....
Total, ...	....	11.72	1.29	6.08	.36	8.18	9.0	1:5.4
Ration reduced to 1,000 pound standard, ...	....	12.02	1.32	6.24	.37	8.39	9.2	....

This ration is all right as far as it goes, but there is not enough of it. It contains only about half enough digestible matter. It is probable that it is meant for one feed instead of the feed for one day, as twice this amount would be about right with the exception of the oats, which should be left out.

9.—The cows receiving this ration weigh about 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	8½	5.09	.17	2.84	.05	3.13	2.1	....
Cotton seed meal, ...	1½	1.38	.56	.23	.19	1.21	2.0	....
Linseed meal, ...	1	.91	.29	.33	.07	.78	1.2	....
Corn meal, ...	1½	1.28	.08	.95	.05	1.15	1.5	....
Oat meal, ...	2	1.78	.18	.95	.05	1.25	2.2	....
Wheat bran, ...	2	1.76	.24	.78	.06	1.15	1.8	....
Total, ...	....	12.20	1.52	6.03	.47	8.67	10.8	1:4.7
Ration reduced to 1,000 pound standard, ...	....	12.51	1.56	6.24	.48	8.89	11.1	....

This, as the previous ration, does not contain enough of digestible matter. Leaving out the oat meal and taking twice the quantity of the other feeds would improve it.

10.—The cows receiving this ration weigh 1,000 pounds, and are fed for milk for the city market:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover,	8	4.79	.16	2.67	.05	2.94	2.0	....
Clover hay,	7	5.93	.45	2.44	.11	3.14	2.8	....
Gluten meal,	2¾	2.49	.70	1.31	.15	2.35	2.5	....
Wheat bran,	3¾	3.30	.45	1.46	.11	2.15	3.4	....
Corn meal,	2	1.70	.11	1.26	.07	1.53	2.0	....
Oat meal,	1½	1.34	.14	.71	.04	.94	1.7	....
Total,	....	19.55	2.01	9.85	.53	13.05	14.4	1:5.5

This is a well balanced ration, and should give very satisfactory results. It might contain 2 or 3 pounds more digestible matter, which could be added by feeding more corn stover and clover hay.

11.—This ration is fed wholly for milk; the cows receiving it weigh 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage,	15	4.19	2.17	2.30	.17	2.90	1.5	....
Corn stover,	12	7.19	.24	4.01	.07	4.42	2.7	....
Clover hay,	12	10.18	.77	4.19	.19	5.39	4.8	....
Gluten meal,	8	7.23	2.05	3.82	.44	6.86	7.2	....
Wheat bran,	8	7.05	.96	3.11	.23	4.59	7.2	....
Total,	....	35.84	4.19	17.49	1.10	24.16	23.4	1:4.8
Ration reduced to 1,000 pound standard,	....	37.73	4.41	18.41	1.16	25.43	24.6	....

There was probably a mistake made in weighing this ration, as we could never get a cow of this size to eat so much food as it calls for. The ration is well balanced, but am afraid that a good part of the food would pass through the animal unassimilated. Several pounds less corn stover, clover hay and grain should give more economical results. Ten pounds of grain instead of 16 should be sufficient.

12.—The cows receiving this ration weigh 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Meadow hay,*	8½	7.74	.41	3.99	.09	4.59	4.3	....
Corn stover, ...	5½	2.30	.11	1.84	.03	2.02	1.4	....
Wheat bran, ...	2	1.76	.24	.78	.06	1.15	1.8	....
Linseed meal, ...	2	1.82	.59	.65	.14	1.56	2.4	....
Corn-and-cob meal, ...	6	5.09	.26	3.60	.17	4.25	4.5	....
Skimmed milk, ...	8	.76	.28	.38	.03	.74	1.4	....
Total, ...	....	19.47	1.89	11.24	.52	14.31	15.8	1:6.6
Ration reduced to 1,000 pound standard, ...	....	19.97	1.94	11.53	.53	14.68	16.2	....

*Figures for red top hay taken.

Under the conditions in which this ration is used, it could probably not be improved upon, and would, therefore, not care to suggest a change. Good enough had better be left alone.

13.—The cows receiving this ration weigh 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of ration.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	35	9.77	.39	5.50	.39	6.76	3.5	....
Corn stover, ...	10	5.99	.20	3.34	.06	3.68	2.5	....
Clover hay, ...	10	8.47	.64	3.49	.16	4.49	4.0	....
Cotton seed meal, ...	4	3.67	1.49	.60	.51	3.24	5.2	....
Total, ...	....	27.90	2.72	12.93	1.12	18.17	15.2	1:5.7
Ration reduced to 1,000 pound standard, ...	....	28.62	2.79	13.26	1.15	18.64	15.6	....

This ration contains more digestible matter than most cows will eat, but it is probable that some of the corn stover is refused, so that the amount eaten would be nearly right. The amount of cotton seed meal fed is rather large, as it tends to produce constipation and garget, but the ensilage fed will, to a great extent, counteract this tendency.

14.—The cows receiving this ration weigh 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	12	7.19	.24	4.01	.07	4.42	2.7	....
Clover hay, ...	10	8.47	.64	3.49	.16	4.49	4.0	....
Germ meal, ...	4	2.82	.52	1.71	1.07	4.68	3.4	....
Cotton seed meal, ...	2½	2.30	.93	.38	.32	2.02	3.3	....
Total, ...	....	20.78	2.33	9.59	1.62	15.61	13.4	1:5.7
Ration reduced to 1,000 pound standard, ...	....	21.31	2.39	9.84	1.66	16.01	13.7	....

This is a well balanced ration, is not expensive, and under many conditions could not be improved upon very much for a dry feed. If the person using it could have ensilage, and substitute it for some of the corn stover and clover hay, it might give better results.

15.—This ration is fed for milk to cows weighing 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	14	12.00	.66	5.50	.21	6.64	6.3	....
Corn stover, ...	6	3.59	.12	2.00	.04	2.21	1.5	....
Wheat bran, ...	3	2.64	.36	1.17	.09	1.72	1.8	....
Corn-and-cob meal, ...	5½	4.67	.24	3.30	.16	3.90	4.1	....
Total, ...	....	22.90	1.38	11.97	.50	14.47	13.7	1:9.5
Ration reduced to 1,000 pound standard, ...	....	24.11	1.45	12.60	.53	15.23	14.4	....

This ration contains about enough digestible matter, but it is not in the right proportion, as it does not contain enough protein. With the feeds given it would be very difficult to compound an economical ration. Four pounds less hay and adding 2 pounds linseed meal or buckwheat middlings would improve it.

16.—This ration is fed for butter to cows weighing 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	16	13.71	.75	6.29	.24	7.58	7.2	....
Wheat bran, ...	2	1.76	.24	.78	.06	1.15	1.8	....
Gluten meal, ...	5½	4.97	1.41	2.62	.30	4.71	5.0	....
Corn-and-cob meal, ...	2½	2.12	.11	1.50	.07	1.77	1.9	....
Total, ...	....	22.56	2.51	11.19	.67	15.21	15.9	1 :5.1
Ration reduced to 1,000 pound standard, ...	....	23.14	2.57	11.48	.69	15.60	16.3	....

This ration is well balanced in every way, and would be hard to improve upon for a dry feed.

17.—This ration is fed principally for butter to cows weighing 750 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	12	8.68	.56	4.72	.18	5.68	5.4	....
Corn stover, ...	5	3.00	.10	1.67	.03	1.84	1.3	....
Corn-and-cob meal, ...	4	3.40	.18	2.40	.12	2.84	3.0	....
Ground oats, ...	3	2.68	.28	1.42	.08	1.88	3.3	....
Wheat bran, ...	2	1.78	.24	.78	.06	1.14	1.8	....
Total, ...	....	19.54	1.36	10.99	.47	13.38	14.8	1:8.9
Ration reduced to 1,000 pound standard, ...	....	26.05	1.81	14.65	.63	17.84	19.7	....

The nutritive ration is too wide, and the ration is rather heavy. Two pounds less hay and 3 pounds oat meal substituted for 2 pounds buckwheat middlings, linseed meal, gluten meal or cotton seed meal would improve it. Oats, as a rule, are to expensive to be used in dairy feeding. It is very often economical to sell them and buy some of the foods that contain more protein, such as cotton seed meal, linseed meal, gluten meal, bran, etc.

18.—This ration is fed principally for butter to cows weighing 780 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay,	12	8.68	.56	4.72	.18	5.68	5.4	....
Corn stover,	5	3.00	.10	1.67	.03	1.84	1.3	....
Corn-and-cob meal,	4	3.40	.18	2.40	.12	2.84	3.0	....
Wheat bran,	2	1.78	.24	.78	.06	1.14	1.8	....
Linseed meal,	2	1.82	.59	.65	.14	1.56	2.4	....
Total,	....	18.68	1.67	10.22	.53	13.06	13.9	1 :7.0
Ration reduced to 1,000 pound standard,	....	24.91	2.22	13.63	.71	17.41	18.5	....

This is a fairly well-balanced ration, and for a dry feed should give good results. As a rule, dry feed cannot be expected to give as good results as a succulent one. The most economical way of supplying succulent food for winter is by means of the silo.

19.—The cows receiving this ration weigh 925 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage,	20	5.58	.22	3.14	.22	3.86	2.0	....
Mixed hay,	8	6.86	.38	3.14	.12	3.79	.36	....
Corn stover,	4	2.40	.08	1.34	.02	1.47	1.0	....
Corn meal,	4	3.40	.22	2.53	.14	3.06	4.0	....
Wheat bran,	4	3.52	.48	1.56	.12	2.30	3.6	....
Cotton seed meal,	1	.92	.37	.15	.13	.81	1.3	....
Total,	....	22.68	1.75	11.86	.75	15.29	15.5	1:7.7
Ration reduced to 1,000 pound standard,	....	24.52	1.89	12.82	.81	16.53	16.7	....

This is a fairly well-balanced ration, but should prefer to have more protein in it. Substituting 1 pound corn meal with 1 pound more cotton seed meal would probably give better results.

20.—This ration is fed for butter to cows weighing 1,000 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage,	64	17.86	.70	10.05	.70	12.35	6.4	....
Corn-and-cob meal,	3⅓	2.83	.15	2.00	.10	2.36	2.5	....
Wheat bran,	3⅓	2.94	.40	1.30	.10	1.91	3.0	....
Linseed meal,	3⅓	3.03	.98	1.09	.23	2.59	4.0	....
Total,	....	26.63	2.23	14.44	1.13	19.21	15.9	1:7.6

There was probably a mistake made in determining the amount of ensilage fed, as it is considerably more than the average cow can consume in connection with 10 pounds of grain. 40 to 45 pounds ensilage would be nearer right.

21.—This ration is fed to a herd of registered Guernsey's that weigh 975 pounds.

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	8	4.79	.16	2.67	.05	2.94	2.0	....
Mixed hay, ...	6	4.34	.28	2.36	.09	2.84	2.7	....
Wheat bran, ...	3	2.64	.36	1.17	.09	1.72	1.8	....
Gluten meal, ...	4	3 62	1.02	1.91	.22	3.43	3.6	....
Cotton seed meal, ...	2	1.84	.74	.30	.25	1.62	2.6	....
Linseed meal, ...	1½	1.36	.44	.49	.11	1.17	1.8	....
Total, ...	....	18.59	3.00	8.90	.81	13.72	14.5	1:3.6
Ration reduced to 1,000 pound standard, ...	....	19.07	3.08	9.13	.83	14.07	14.9	....

This is a very narrow and cheap ration, and doubt whether it could be improved upon very much, except that there might be some succulent food, such as ensilage substituted for 3 or 4 pounds coarse fodder and 1 or 2 pounds grain.

22.—This ration is fed for milk to cows weighing 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	6	4.34	.28	2.36	.09	2.84	2.7	....
Wheat middlings, ...	8	7.03	1.02	4 26	.27	5.90	7.6	....
Corn meal, ...	10	8.50	.55	6.32	.35	7.66	10.0	....
Wheat bran, ...	4	3.52	.48	1.56	.12	2.30	3.6	....
Corn stover, ...	6	3.50	.12	2.00	.04	2.21	1.5	....
Total, ...	....	26 98	2.45	16.50	.87	20.91	25.4	1:7.5
Ration reduced to 1,000 pound standard, ...	....	28.40	2.58	17.37	.92	22.01	26.7	....

This ration contains about twice the amount of grain that is usually fed, and it is too expensive to be practical. A decided improvement would be: mixed hay, 7 pounds; corn stover, 7 pounds; wheat middlings, 4 pounds; wheat bran, 2 pounds; corn meal, 4 pounds; linseed meal or cotton seed meal, 2 pounds.

23.—The cows receiving this ration weigh 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	6	4.34	.28	2.36	.09	2.84	2.7	....
Corn stover, ...	5	3.00	.10	1.67	.03	1.84	1.3	....
Corn meal, ...	6	5.10	.33	3.79	.21	4.60	6.0	....
Wheat bran, ...	6	5.29	.72	2.33	.17	3.44	5.4	....
Total, ...	....	17.73	1.43	10.15	.50	12.72	15.4	1:7.9
Ration reduced to 1,000 pound standard, ...	....	18.66	1.51	10.68	.53	13.39	16.2	....

The amount of coarse fodder fed in this ration is rather small, and the nutritive ratio is too wide, or, in other words, it does not contain enough protein. An improvement would be: mixed hay, 9 pounds; corn stover, 8 pounds; corn meal, 5 pounds; wheat bran, 6 pounds; linseed meal or cotton seed meal, 2 pounds.

24.—The cows receiving this ration weigh 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	6	4.34	.28	2.36	.09	2.84	2.7	....
Corn stover, ...	5	3.00	.10	1.67	.03	1.84	1.3	....
Corn meal, ...	3	2.55	.17	1.90	.11	2.30	3.0	....
Cotton seed meal, ...	3	2.75	1.12	.45	.38	2.43	3.9	....
Wheat bran, ...	6	5.29	.72	2.33	.17	3.44	5.4	....
Total, ...	....	17.93	2.39	8.71	.78	12.85	16.3	1:4.4
Ration reduced to 1,000 pound standard, ...	....	18.87	2.52	9.17	.82	13.53	17.2	....

The nutritive ratio of the ration is nearly right, but the dry matter and digestible matter is too low. Would prefer to feed more coarse fodder and less grain. The coarse fodder recommended for the previous ration and 1 or 2 pounds less bran should improve it.

25.—This ration is fed principally for butter to cows weighing 970 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	33	9.21	.36	5.18	.36	6.37	3.3	....
Mixed hay, ...	11	9.43	.52	4.32	.17	5.21	5.0	....
Corn meal, ...	2	1.70	.11	1.26	.07	1.53	2.0	....
Wheat bran, ...	3	2.64	.36	1.17	.09	1.72	2.7	....
Buckwheat middlings. ..	2	1.74	.47	.74	.12	1.48	1.8	....
Total, ...	....	24.72	1.82	12.67	.81	16.31	14.8	1:8.0
Ration reduced to 1,000 pound standard, ...	....	25.49	1.88	13.06	.84	16.82	15.3	....

This ration, although not as close to the standard as might be, should give fairly satisfactory results. Other things being equal, 4 pounds buckwheat middlings, 1 pound bran and the same amount of ensilage, hay and corn meal would be a better ration.

26.—The cows receiving this ration weigh about 850 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	6	3.59	.12	2.00	.04	2.21	1.5	....
Mixed hay, ...	3	2.57	.14	1.18	.05	1.42	1.4	....
Corn meal, ...	3½	2.98	.19	2.22	.12	2.68	3.5	....
Gluten meal, ...	2½	2.26	.64	1.19	.14	2.14	2.3	....
Wheat middlings, ...	3	2.63	.38	1.60	.10	2.21	2.9	....
Cotton seed meal, ...	3	2.75	1.12	.45	.38	2.43	3.9	....
Total, ...	....	16.78	2.59	8.63	.83	13.09	15.5	1:4.0
Ration reduced to 1,000 pound standard, ...	....	19.74	3.05	10.15	.98	15.40	18.2	....

This ration contains too much grain for the amount of coarse fodder in it. It might do very well for some time, but would probably, if fed too long, derange the digestive system of the animal. An improvement would be: corn stover, 8 pounds; mixed hay, 6 pounds; corn meal, 2 pounds; gluten meal, 2½ pounds; wheat middlings, 3 pounds; cotton seed meal, 2 pounds.

27.—The cows to which this ration is fed weigh 850 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	6	3.59	.12	2.00	.04	2.21	1.5	....
Mixed hay, ...	3	2.57	.14	1.18	.05	1.42	1.4	....
Linseed meal, ...	3	2.72	.88	.98	.21	2.33	3.6	....
Corn meal, ...	4	3.40	.22	2.53	.14	3.06	4.0	....
Wheat middlings, ...	4½	3.96	.58	2.39	.15	3.32	4.3	....
Total, ...	....	16.24	1.94	9.08	.59	12.34	14.8	1:5.4
Ration reduced to 1,000 pound standard, ...	....	19.11	2.28	10.68	.69	14.52	17.4	....

This ration contains about the proper amount of digestible matter, and the nutritive ratio is that of the Germany standard. As in the previous ration, the amount of coarse fodder is too small for the amount of grain fed, and should prefer the following: Corn stover, 8 pounds; mixed hay, 8 pounds; linseed meal, 3 pounds; corn meal, 2 pounds; wheat middlings, 4 pounds.

28.—This ration is fed for the production of butter to cows weighing 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage,	50	13.95	.55	7.85	.55	9.65	5.0	....
Mixed hay,	8	6.86	.38	3.14	.12	3.79	3.6	....
Gluten meal,	8	7.23	2 05	3.82	.44	6.86	7.2	....
Total,	....	28.04	2.98	14.81	1.11	20.30	15.8	1:5.8
Ration reduced to 1,000 pound standard,	....	28.76	3.06	15.19	1.14	20.82	16.2	....

This ration is fairly well-balanced, but contains more digestible matter than the average cow weighing 975 pounds can assimilate. Our experience with gluten meal has not been too satisfactory, as the cows did not eat it very readily, and it caused more or less constipation. However, the cows were fed no succulent food at the time. As this ration is composed largely of ensilage, this effect may not occur. Ten pounds less ensilage would probably give more economical results.

29.—This ration is fed for butter to cows weighing 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	25	6.93	.28	3.93	.28	4.83	2.5	....
Timothy hay, ...	5	4.34	.15	2.19	.07	2.49	2.5	....
Millet hay, ...	5	4.62	.21	2.34	.05	2.66	1.8	....
Corn meal, ...	4	3.40	.22	2.53	.14	3.06	4.0	....
Oat meal, ...	2	1.78	.18	.95	.05	1.25	2.2	....
Total, ...	....	21.12	1.01	11.94	.59	14.29	13.0	1: 2 8
Ration reduced to 1,000 pound standard, ...	....	21.63	1.07	12.25	.61	14.63	13.3	....

This ration would be better for fattening steers than for milch cows. It contains nearly enough digestible matter but not enough digestible protein or the part of the food which forms milk. With the feeds given a proper ration could not be compounded; some nitrogenous by-product would have to be purchased to make it an economical ration. Ensilage, 25 pounds; timothy hay, 3 pounds; millet hay, 5 pounds; corn meal, 3 pounds; oat meal, 1 pound; linseed meal, 2 pounds; cotton seed meal or gluten meal, 2 pounds, would be an improvement.

30.—The cows to which this ration is fed weigh 850 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	10	8.57	.47	3.93	.15	4.74	4.5	....
Wheat bran, ...	2½	2.20	.30	.97	.07	1.44	2.3	....
Corn meal, ...	7	5.95	.39	4.42	.25	5.36	7.0	....
Corn stover, ...	3	1.80	.06	1.00	.02	1.10	.8	....
Total, ...	....	18.52	1.22	10.32	.49	12.64	14.6	1:9.4
Ration reduced to 1,000 pound standard, ...	....	21.79	1.44	12.14	.58	14.87	17.2	....

This ration does not contain enough protein, and would be very much improved if only 3 or 4 pounds of corn meal were fed and 3 or 4 pounds of linseed meal, buckwheat middlings or gluten meal were added; the amount of corn stover might be increased 3 or 4 pounds.

31.—This ration is fed for milk to cows that weigh 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbbydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	50	13.95	.55	7.85	.55	9.65	5.0	....
Corn stover, ...	9	5.40	.18	3.00	.06	3.30	2.3	....
Corn-and-cob meal, ...	3	2.55	.13	1.89	.09	2.13	2.3	....
Wheat bran, ...	2	1.76	.24	.78	.06	1.15	1.8	....
Linseed meal, ...	1	.91	.29	.33	.07	.78	1.2	....
Total, ...	....	24.57	1.39	13.76	.83	17.01	12.6	1:11.2
Ration reduced to 1,000 pound standard, ...	....	25.86	1.46	14.43	.87	17.91	13.3	....

This ration would be better for fattening steers than for milch cows, as for every pound of milk producing food it contains 11.2 pounds of heat and fat producing food. Ensilage, 35 pounds; corn stover, 9 pounds; corn-and-cob meal, 3 pounds; wheat bran, 2 pounds; linseed meal or cotton seed meal, 3 or 4 pounds, would probably give a better quality of milk.

32.—This ration is fed to cows weighing 1,000 pounds.

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbbydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	19	5.30	.21	2.93	.21	3.67	1.9	....
Corn stover, ...	7	4.19	.14	2.34	.04	2.58	1.8	....
Corn-and-cob meal, ...	5	4.25	.22	3.00	.14	3.55	3.8	....
Wheat bran, ...	5	4.41	.69	1.95	.15	2.87	4.5	....
Total, ...	....	18.15	1.17	10.27	.54	12.67	12.0	1:9.8

The nutritive ratio of this ration is too wide, and it does not contain enough digestible matter. A ration composed of the following should give better results: Ensilage, 25 pounds; corn stover, 8 pounds; corn-and-cob meal, 4 pounds; wheat bran, 3 pounds; cotton seed meal, 3 pounds.

33.—The cows receiving this ration weigh 875 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Clover hay, ...	15	12.71	.96	5.24	.25	6.74	6.0	....
Oat straw, ...	6	5.45	.08	2.63	.05	2.84	1.5	....
Oat meal, ...	6	5.34	.55	2.84	.16	3.74	6.6	....
Total, ...	....	23.50	1.59	10.71	.46	13.32	14.1	1:7.4
Ration reduced to 1,000 pound standard, ...	....	26.86	1.82	12.24	.53	15.22	16.1	....

There are circumstances under which this ration might be the most economical one that could be fed, but where the farmer does not live too far from the market, it is often profitable to exchange the oats for by-products, such as cotton seed meal, linseed meal, gluten meal or bran. Not knowing the conditions under which the ration is used, it is hard to give any suggestions as how best to improve it. Disregarding the local conditions, the following should give better results: Clover hay, 12 pounds; oat straw, 6 pounds; oat meal, 4 pounds; wheat bran, wheat middlings or buckwheat middlings, 2 pounds; linseed meal or cotton seed meal, 2 pounds.

34.—This ration is fed for butter to cows weighing 875 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	5	3.00	.10	1.67	.03	1.84	1.3	....
Wheat chaff, ...	3	2.71	.09	.70	.02	.84	.8	....
Timothy hay, ...	12	10.42	.35	5.20	.17	5.98	6.0	....
Linseed meal, ...	2	1.82	.59	.65	.14	1.56	2.4	....
Corn-and-cob meal, ...	4½	3.82	.20	2.70	.13	3.19	3.4	....
Buckwheat middlings, ..	3¾	3.26	.89	1.39	.23	2.78	3.4	....
Total, ...	....	25.03	2.22	12.31	.72	16.19	17.3	1:6.3
Ration reduced to 1,000 pound standard, ...	....	28.61	2.54	14.07	.82	18.50	19.8	....

This ration is well-balanced but is rather expensive, and contains more digestible matter than the average cow can assimilate. Two pounds less timothy hay and 1½ pounds less corn-and-cob meal would improve it. When not too far from a railroad station or town, timothy hay is usually worth more to sell than it is to feed to dairy cows. The nutritive ratio is 1:16.2 and it, therefore, tends to develop fat and not milk.

35.—This ration is fed to cows weighing 875 pounds:

—	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay,	14	12.00	.66	5.50	.22	6.64	6.3	....
Corn stover,	9½	5.69	.19	3.17	.06	3.50	2.4	....
Wheat bran,	2	1.76	.24	.78	.06	1.15	1.8	....
Linseed meal,	1	.91	.29	.33	.07	.78	1.2	....
Corn-and-cob meal,	3¼	2.76	.14	1.95	.09	2.30	2.4	....
Ground oats,	2½	2.23	.23	1.18	.07	1.56	2.8	....
Total,	....	25.35	1.75	12.91	.57	15.93	16.9	1:8.1
Ration reduced to 1,000 pound standard,	....	28.97	2.00	14.75	.65	18.21	19.3	....

This ration contains about the right amount of grain, but too large an amount of coarse fodder. Ten pounds mixed hay and 8 or 9 pounds corn stover, with the grain given would cheapen the ration and give as good results.

36.—This ration is fed for milk and butter to cows weighing 725 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Meadow hay, ...	8	7.29	.38	3.75	.08	4.32	3.6	....
Corn stover, ...	8	4.79	.16	2 67	.05	2.94	1.8	....
Wheat bran, ...	3	2.64	.36	1.17	.09	1.72	2.7	....
Corn-and-cob meal, ...	2	1.70	.09	1.20	.06	1.42	1.5	....
Total, ...	....	16.42	.99	8.79	.28	10.40	9.6	1:9.5
Ration reduced to 1,000 pound standard, ...	....	22.65	1.37	12.12	.39	14.35	13.2	....

The nutritive ratio of this ration is to wide, and it does not contain enough digestible matter. An addition of 2 or 3 pounds linseed meal would improve it.

37.—This ration is fed to cows weighing 825 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	20	11.98	.40	6.63	.12	7.36	5.0	....
Ground oats, ...	3	2.63	.23	1.42	.08	1.88	3.3	....
Corn-and-cob meal, ...	6	5.09	.26	3.60	.17	4.25	4.5	....
Rutabagas, ...	10	1.14	.10	.81	.02	.93	1.5	....
Total, ...	....	20.89	1.04	12.51	.39	14.44	14.3	1:12.9
Ration reduced to 1,000 pound standard, ...	....	25.32	1.26	15.16	.47	17.50	17.3	....

This ration would be better for fattening steers than for milch cows, as it does not contain enough protein. With the foods given it would be impossible to compound a well-balanced ration. Rutabagas do very well for winter feeding when no other succulent food can be obtained. Ensilage will serve the same purpose, and can be grown at very much less expense per pound of digestible matter than can rutabagas. An improvement on the ration would be: Corn stover, 16 pounds; ground oats, 2 pounds; corn-and-cob meal, 4 pounds; rutabagas, 10 pounds; linseed meal, 3 pounds, or linseed meal, 1½ pounds, and cotton seed meal, 1½ pounds.

38.—This ration is fed to grade Jersey's and Guernsey's that weigh 890 pounds, for the production of milk and cream:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover,	13	7.79	.26	4.34	.08	4.78	3.3	....
Wheat bran,	4	3.52	.48	1.56	.12	2.30	3.6	....
Linseed meal,	2	1.82	.59	.65	.14	1.56	2.4	....
Corn-and-cob meal,	4	3.49	.18	2.49	.12	2.84	3.0	....
Oat straw,	3	2.73	.04	1.32	.03	1.42	.8	....
Total,	....	19.25	1.56	10.27	.49	12.90	13.1	1:7.3
Ration reduced to 1,000 pound standard,	....	21.64	1.75	11.54	.55	14.50	14.7	....

The nutritive ratio might be some narrower, and the ration might contain 1 or 2 pounds more digestible matter. The ration might be improved by feeding only 10 pounds corn stover and adding 4 or 5 pounds clover hay.

39.—This ration is fed to the same cows as the previous ration:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Clover, hay,	12	10.18	.77	4.19	.19	5.39	4.8	....
Wheat bran,	4	3.52	.43	1.56	.12	2.30	36	....
Corn-and-cob meal,	4	3.49	.18	2.40	.12	2.84	3.0	....
Linseed meal,	2	1.82	.59	.65	.14	1.56	2.4	....
Total,	....	18.92	2.02	8.80	.57	12.09	13.8	1:5.0
Ration reduced to 1,000 pound standard,	....	21.26	2.27	9.89	.64	13.58	15.5	....

This ration is well-balanced; the only criticism would be that there is not enough of it. If 6 pounds corn stover were added, it would be improved, or, better still, 25 pounds ensilage added and 2 pounds corn-and-cob meal taken off.

40.—This ration is fed to cows weighing 675 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	20	11.98	.40	6.68	.12	7.36	5.0	....
Mixed hay, ...	10	8.57	.47	3.93	.15	4.74	4.5	....
Gluten meal, ...	10	9.04	2.56	4.77	.55	8.57	9.0	....
Wheat bran, ...	2	1.76	.24	.78	.06	1.15	1.8	....
Total, ...	....	31.35	3.67	16.16	.88	21.82	20.3	1:4.9
Ration reduced to 1,000 pound standard, ...	....	46.45	5.44	23.94	1.30	32.33	30.1	....

There was probably a mistake made in the weight of the food or cows, as when the ration is reduced to the 1,000 pound standard it will be observed that it contains about twice as much digestible matter as the ordinary cow is able to assimilate and also the cost (30.1 cents) is entirely too much. A decided improvement would be: Corn stover, 12 pounds; mixed hay, 5 pounds; gluten meal, 5 pounds; wheat bran, 3 pounds. That is, assuming the cows weigh only 675 pounds.

41.—This ration is fed for milk of a superior quality, to cows weighing 1,100 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	40	11.16	.14	6.28	.44	7.72	4.0	....
Timothy hay, ...	12	10.42	.35	5.20	.17	5.98	6.0	....
Wheat bran, ...	6	5.29	.72	2.33	.17	3.44	5.4	....
Gluten meal, ...	4	3.62	1.02	1.91	.22	3.43	3.6	....
Linseed meal, ...	2	1.82	.59	.65	.14	1.56	2.4	....
Total, ...	....	32.31	3.12	16.37	1.14	22.13	21.4	1:6.1
Ration reduced to 1,000 pound standard, ...	....	29.37	2.84	14.89	1 04	20.12	19.5	....

This ration is well-balanced, and although it contains more digestible matter than the standard calls for, there are some cows that would consume this amount. Five pounds less ensilage, 2 pounds timothy hay and 1 or 2 pounds wheat bran would be an improvement in some cases.

42.—This ration is fed for butter to full blood and grade Guernsey cows that weigh 1,000 pounds:

	Fresh weight	Dry matter.	Digestible				Cost of ration.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	10	5.99	.20	3.34	.06	3.68	2.5	....
Corn-and-cob meal, ...	8	6.79	.35	4.80	.23	5.67	6.0	....
Altás gluten meal, ...	4	3.62	1.02	1.91	.22	3.43	3.6	....
Linseed meal, ...	1½	1.36	.44	.49	.11	1.17	1.8	....
Total, ...	....	17.76	2.01	10.54	.62	13.95	13.9	1:5.9

This ration is well-balanced, but might contain more coarse fodder. Five or six pounds clover hay added would be an improvement.

43.—This ration is fed for the production of butter to cows weighing 1,000 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay,	10	8.57	.47	3.93	.15	4.74	4.5	....
Hominy meal.	3	2.67	.21	1.91	.21	2.60	2.1	....
Wheat bran,	4	3.52	.48	1.56	.12	2.30	3.6	....
Corn meal,	5	4.25	.28	3.16	.18	3.83	5.0	....
Total,	....	19.01	1.44	10.56	.66	13.47	15.2	1:8.4

In this ration the nutritive ratio is too wide; there is not enough of coarse fodder for the amount of grain, and not enough digestible matter. With the feeds given, it would be impossible to compound a good ration. A ration that should give fairly good results is the following: Mixed hay, 16 pounds; hominy meal, 3 pounds; wheat bran, 2 pounds; corn meal, 2 pounds; linseed meal, 3 or 4 pounds; or linseed meal, 2 pounds, and cotton seed meal or gluten meal, 2 pounds.

44.—This ration is fed for butter to cows weighing 1,000 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage,	38	10.60	.42	5.97	.42	7.33	3.8	....
Wheat bran,	1	.88	.12	.39	.03	.57	.9	....
Buckwheat middlings,	1	.87	.24	.37	.06	.74	.9	....
Ground oats,	1	.89	.09	.47	.03	.62	1.1	....
Corn-and-cob meal,	6	5.09	.26	3.60	.17	4.25	4.5	....
Total,	....	18.33	1.13	10.80	.71	13.51	11.2	1:11.0

This is a very cheap ration, but the nutritive ratio is too wide, and does not contain enough digestible matter. Four or 5 pounds clover hay added and 2 or 3 pounds buckwheat middlings substituted for an equal weight of corn-and-cob meal would be an improvement.

45.—This ration is fed for butter to Jersey cows that weigh 900 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay,	10	8.57	.47	3.93	.15	4.74	4.5	....
Corn meal,	4	3.40	.22	2.53	.14	3.06	4.0	....
Oat meal,	3	2.67	.28	1.42	.08	1.87	3.3	....
Wheat bran,	3	2.64	.36	1.17	.09	1.72	2.7	....
Corn stover,	5	3.00	.10	1.67	.03	1.84	1.3	....
Total,	....	20.28	1.43	10.72	.49	13.23	15.8	1:8.3
Ration reduced to 1,000 pound standard,	....	22.53	1.59	11.91	.54	14.70	17.6	....

This ration is deficient in protein and total digestible matter. There are conditions under which it might be the most economical ration that could be compounded; but should prefer to have 2 or 3 pounds more corn stover and 3 pounds linseed meal or buckwheat middlings substituted for the 3 pounds of oats.

46.—This ration is fed for butter to Jersey cows weighing 925 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage,	37	10.32	.42	5.81	.41	7.14	3.7	....
Corn stover,	3	3.59	.12	2.00	.04	2.21	1.5	....
Wheat bran,	5	4.41	.60	1.95	.15	2.87	4.5	....
Corn meal,	4	3.40	.22	2.53	.14	3.06	4.0	....
Total,	....	21.72	1.36	12.29	.71	15.28	13.7	1:10.3
Ration reduced to 1,000 pound standard,	....	23.48	1.47	13.29	.80	16.52	14.8	....

This ration contains about the right amount of total digestible matter but not enough protein. An improvement would be: Ensilage, 37 pounds; corn stover, 6 pounds; wheat bran, 3 pounds; corn meal, 2 pounds; cotton seed meal, 2 or 3 pounds; linseed meal or buckwheat middlings, 1 or 2 pounds.

47.—The cows receiving this ration weigh 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	20	17.16	.94	7.86	.30	9.84	9.0	....
Corn meal, ...	2½	2.13	.14	1.58	.09	1.92	2.5	....
Gluten meal, ...	5	5.52	1.28	2.38	.28	4.28	4.5	....
Wheat bran, ...	2½	2.20	.30	.97	.07	1.44	2.3	....
Total, ...	....	27.01	2.63	12.79	.74	17.12	18.3	1:5.4
Ration reduced to 1,000 pound standard, ...	....	28.43	2.80	13.46	.78	18.02	19.3	....

This is a very well-balanced ration; the grain and coarse fodder is well-proportioned and under some conditions would be the most economical ration that could be compounded. It contains nearly two pounds more digestible matter than the average cow can assimilate, but as to whether the amount should be reduced in this case is a matter that would have to be left to the judgment of the person using it.

48. The cows to which this ration is fed weigh 925 pounds.

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	15	12.81	.71	5.90	.23	7.11	6.8	....
Corn-and-cob meal, ...	12	10.18	.52	7.20	.34	8.50	9.0	....
Wheat bran, ...	3	2.64	.36	1.17	.09	1.72	2.7	....
Linseed meal, ...	3	2.73	.87	.99	.21	2.34	3.6	....
Total, ...	....	26.36	2.46	15.26	.87	19.67	22.1	1:7.0
Ration reduced to 1,000 pound standard, ...	....	28.50	2.66	16.50	.94	21.27	23.9	....

The amount of grain fed in this ration is too heavy. We tried to feed this amount to 9 cows in 1893-94, but only 3 ate it. Some of the cows were injured by the heavy feeding and the increased production of milk and butter did not pay for the increase in the cost of the feed. An improvement on the above would be: Mixed hay, 16 pounds; corn-and-cob meal, 6 pounds; wheat bran, 2 pounds; linseed meal, 3 pounds.

49.—This ration is fed for butter to grade Jersey and Guernsey cows that weigh 955 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Clover hay, ...	12	10.18	.77	4.19	.19	5.39	4.8	....
Timothy hay, ...	8	6.94	.23	3.50	.11	3.98	4.0	....
Corn stover, ...	10	5.99	.20	3.34	.06	3.68	2.5	....
Wheat bran, ...	4	3.52	.48	1.56	.12	2.30	3.6	....
Corn-and-cob meal, ...	2	1.70	.09	1.20	.06	1.42	1.5	....
Total, ...	....	28.33	1.77	13.79	.54	16.77	16.4	1:8.5
Ration reduced to 1,000 pound standard, ...	....	29.67	1.85	14.44	.57	17.56	17.2	....

The amount of coarse fodder in this ration is very heavy. It is considerable more than the average cow can consume. If a person is far from market this ration might be justifiable; but should prefer to have less coarse fodder and more grain. In this case it might be well to exchange the timothy hay for some by-product, such as linseed meal, cotton seed meal or gluten meal. An improvement would be: Clover hay, 12 pounds; corn stover, 10 pounds; wheat bran, 4 pounds; corn-and-cob meal, 2 pounds; linseed meal or gluten meal, 4 pounds; or linseed meal, 2 pounds; and cotton seed meal, 2 pounds.

50.—This ration is fed to cows weighing 750 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Clover, hay, ...	18	15.25	1.15	6.28	.29	8.08	7.2	....
Wheat bran, ...	4	3.52	.48	1.56	.12	2.30	3.6	....
Corn meal, ...	4	3.40	.22	2.53	.14	3.06	4.0	....
Gluten meal, ...	4	3.62	1.02	1.91	.22	3.43	3.6	....
Potatoes, ...	7	1.48	.06	1.10	.00	1.16	1.8	....
Total, ...	....	27.27	2.93	13.38	.77	18.03	20.2	1:5.2
Ration reduced to 1,000 pound standard, ...	....	36.36	3.91	17.84	1.03	24.04	26.9	....

This ration would be very good for a 1,000 or 1,100 pound cow, but for cows weighing only 750 pounds it is too heavy. Potatoes tend to produce a thin, watery milk, but when they are as cheap as they were last season they can be fed to very good advantage. A ration that would be nearer right for a 750 pound cow would be: Clover hay, 15 pounds; potatoes, 7 pounds; wheat bran, 2 pounds; corn meal, 3 pounds; gluten meal, 3 pounds.

51.—The cows receiving this ration weigh 1,000 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	53⅓	9.30	.37	5.23	.37	6.43	3.3	....
Mixed hay, ...	8	6.86	.38	3.14	.12	3.79	3.6	....
Cotton seed meal, ...	2	1.84	.74	.30	.25	1.62	2.6	....
Buckwheat middlings, ..	3	2.60	.71	1.11	.18	2.23	2.7	....
Rye straw, ...	8¾	8.15	.05	3.55	.04	3.77	3.0	....
Total, ...	....	28.75	2.25	13.33	.96	17.84	15.2	1:6.9

This is a well-balanced ration and is very cheap. The amount of grain fed is rather light in comparison to the amount of coarse fodder fed. But if the farmer has a large amount of coarse fodder to dispose of it might be the best ration that he could compound.

The person using this ration, presumably, has studied carefully the matter of dairy feeding and can readily change it from time to time to suit his own local conditions.

52.—This ration is fed for butter to Jersey cows that weigh about 750 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay,	10	8.57	.47	3.93	.15	4.74	4.5	....
Corn stover,	10	5.99	.20	3.34	.06	3.68	2.5	....
Corn meal,	5	4.25	.28	3.16	.18	3.83	5.0	....
Oat meal,	3	2.67	.28	1.42	.08	1.87	3.3	....
Total,	....	21.48	1.23	11.85	.47	14.12	15.3	1:10.5
Ration reduced to 1,000 pound standard,	....	28.63	1.64	15.80	.63	18.83	20.4	....

This ration does not contain enough protein, and would tend to produce fat instead of milk. With the feeds given it would be impossible to compound a well-balanced ration. Mixed hay, 8 pounds; corn stover, 8 pounds; corn meal, 4 pounds; wheat bran or middlings, 1 pound; linseed meal, 3 pounds; or linseed meal, 2 pounds; cotton seed meal, 1 pound, would be an improvement, and should give more economical results.

53.—This ration is fed to cows weighing on an average about 1,000 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage,	20	8.37	.33	4.71	.33	5.79	3.0	....
Mixed hay,	8	6.86	.38	3.14	.12	3.79	3.6	....
Wheat bran,	4	3.52	.48	1.56	.12	2.30	3.6	....
Cerealine,	4	3.62	.36	2.14	.26	3.09	2.4	....
Cotton seed meal,	2	1.84	.74	.30	.25	1.62	2.6	....
Total,	....	21.21	2.29	11.85	1.08	16.59	15.2	1:6.4

This is a very well-balanced ration, and trying to improve it might make it worse. It will need to be changed from year to year, as the prices of the different foods change, a matter which can be left to the judgment of the person using the ration.

54.—Same as No. 53:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	30	8.37	.33	4.71	.33	5.79	3.0	....
Mixed hay, ...	8	6.83	.78	3.14	.12	3.79	3.6	....
Wheat bran, ...	4	3.52	.18	1.76	.12	2.30	3.6	....
Atlas gluten meal, ...	4	3.62	1.02	1.91	.22	3.43	3.6	....
Cotton seed meal, ...	2	1.84	.74	.30	.25	1.62	2.6	....
Total, ...	....	24.21	2.95	11.62	1.04	16.93	16.4	1:4.8

This ration costs 1.2 cents more than the previous one, but the nutritive ratio is considerably narrower and should expect more butter from it. It would be hard to improve upon, and good enough had better be left alone.

55.—The cows receiving this ration weigh 925 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	40	11.16	.44	6.28	.44	7.72	4.0	....
Wheat bran, ...	8	7.04	.96	3.12	.24	4.60	7.2	....
Corn-and-cob meal, ...	4	3.40	.18	2.40	.12	2.84	3.0	....
Ground oats, ...	2	1.78	.18	.95	.05	1.25	2.2	....
Total, ...	....	23.38	1.76	12.75	.85	16.41	16.4	1:8.3
Ration reduced to 1,000 pound standard, ...	....	25.28	1.90	13.78	.92	17.74	17.6	....

Five or 6 pounds clover hay added, and 3 or 4 pounds less bran would improve this ration. The amount of protein is deficient. This could be remedied by substituting the 2 pounds oats with 2 pounds cotton seed meal.

56.—This ration is fed for milk for the city market, to cows weighing 1,100 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	18	10.77	.36	6.00	.12	6 63	4.5	....
Corn-and-cob meal, ...	8	3.40	.18	2.40	.12	2.84	6.0	....
Wheat bran, ...	3	2.64	.26	1.17	.09	1.72	2 7	....
Linseed meal, ...	1½	1.36	.41	.49	.11	1.17	2 0	....
Total, ...	....	18.17	1.34	10.06	.44	12.33	15.2	1:8.2
Ration reduced to 1,000 pound standard, ...	....	16.52	1.22	9.15	.40	11.24	13.8	....

The nutritive ratio in this ration is too wide and it does not contain enough digestible matter for a 1,100 pound cow. An improvement would be: Corn stover, 20 pounds; or corn stover, 14 pounds; and clover hay, 6 pounds; corn-and-cob meal, 6 pounds; wheat bran, 3 pounds; linseed meal, 4 pounds; or linseed meal, 2 pounds; cotton seed meal, 2 pounds.

57.—This ration is fed to cows that weigh 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	4	3.43	.19	1.57	.06	1.90	1.8	....
Corn stover, ...	6	3.59	.12	2.00	.04	2.21	1.8	....
Potatoes, ...	10	2.11	.09	1.57	....	1.66	2.5	....
Corn meal, ...	5	4.25	.28	3.16	.18	3.83	5.0	....
Oat meal, ...	3	2 67	.28	1.42	.08	1.87	3.3	....
Wheat bran, ...	4	3.52	.48	1.56	.12	2.30	3.6	....
Total, ...	....	19.57	1.44	11.28	.48	13.77	17.7	1:8.6
Ration reduced to 1,000 pound standard, ...	....	20.07	1.48	11.57	.49	14 07	18.2	....

The nutritive ratio of this ration is too wide, and it does not contain enough digestible matter; it is also deficient in coarse fodder.

With the feeds given it would be impossible to compound a well-balanced ration. Mixed hay, 6 pounds; corn stover, 8 pounds; potatoes, 10 pounds; corn meal, 4 pounds; wheat bran, 4 pounds; linseed meal, 3 pounds, is a ration that should give better results than the above.

58.—The cows receiving this ration weigh 980 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay,	20	17.16	.94	7.86	.30	9.48	9.0	....
Cotton seed meal,	1½	1.36	.44	.49	.11	1.17	2.0	....
Corn meal,	2½	2.13	.14	1.58	.09	1.92	2.5	....
Wheat bran,	5½	4.85	.66	2.14	.16	3.16	5.0	....
Total,	....	25.50	2.18	12.07	.66	15.73	18.5	1:6.2
Ration reduced to 1,000 pound standard,	....	26.02	2.22	12.32	.67	16.05	18.9	....

This is a very well-balanced ration and contains about the right amount of digestible matter. Under the conditions in which it is fed, it is probably the best ration that could be compounded. By having ensilage it could be materially cheapened and would without a doubt give better results.

59.—This ration is fed for milk for the city market, to grade Jersey and Dutch Belted cows that weigh 1,000 pounds on an average:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay,	12	8.68	.56	4.72	.18	5.68	5.4	....
Corn-and-cob meal,	7	5.94	.31	4.20	.20	4.96	5.3	....
Wheat bran,	3	2.64	.36	1.17	.09	1.72	2.7	....
Linseed meal,	1	.91	.29	.33	.07	.78	1.2	....
Total,	....	18.17	1.52	10.42	.54	13.14	14.6	1:7.7

The nutritive ratio in this ration is too wide; it does not contain enough coarse fodder nor enough digestible matter. An improvement would be: Mixed hay, 18 pounds; corn-and-cob meal, 3 pounds; wheat bran, 3 pounds; linseed meal, 3 or 4 pounds.

60.—Same herd as previous ration:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	35	9.77	.39	5.50	.39	6.76	3.5	....
Wheat bran, ...	8	7.05	.96	3.11	.23	4.59	7.2	....
Total, ...	....	16 82	1.35	8.61	.62	11.35	10.7	1:7.4

This is a very cheap ration, but does not contain enough digestible matter. The nutritive ratio might be some narrower. Six pounds clover hay or some other dry coarse fodder, and 2 or 3 pounds cotton seed meal added would make a more expensive ration, but would in the end, probably, be more economical.

61.—This ration is fed for milk for the city market, to cows weighing 1,000 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	12	7.19	.24	4.01	.07	4.42	3.0	....
Mixed hay, ...	9	6.51	.42	3.54	.14	4.26	4.0	....
Corn meal, ...	3½	2 98	.19	2.22	.12	2.68	3.5	....
Oat meal, ...	3½	3.12	.32	1.66	.09	2.18	3.9	....
Linseed meal, ...	4	3.64	1.16	1.32	.28	3.12	4.8	....
Total, ...	....	23.44	2.33	12.75	.70	16.66	19.2	1:6.2

This is a well-balanced ration and contains about the right amount of digestible matter. It is rather expensive, however, and could be cheapened some by substituting for the 3½ pounds of oats an equal weight of wheat bran or middlings or gluten meal. This, of course, will depend upon the local price of the different materials.

62.—Same herd as No. 61:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	18	10.77	.36	6.00	.12	6.63	4.5	....
Clover, hay, ...	6	5.09	.39	2.10	.10	2.69	2.4	....
Corn meal, ...	8	6.80	.44	5.06	.28	6.13	8.0	....
Cotton seed meal, ...	3	2.75	1.12	.45	.38	2.43	3.9	....
Total, ...	....	25.41	2.31	13.61	.88	17.88	18.8	1:6.7

This ration is fairly well-balanced but contains more digestible matter than the average cow can assimilate. With this large amount of corn stover there is probably more or less refused, so that the amount of food actually consumed would be about right. The ration is liable to produce constipation and garget, and should want to add some food that was more laxative in its effects. Thirty-five pounds ensilage in place of the 18 pounds corn stover, or 8 to 10 pounds of mangels substituted for 5 or 6 pounds of corn stover would improve it. Mangels are more expensive than ensilage, but a small amount can often be grown to advantage.

63.—Same herd as No. 61:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	12	7.19	.24	4.01	.07	4.42	3.0	....
Clover hay, ...	9	7.60	.58	3.14	.14	4.04	3.6	....
Corn-and-cob meal, ...	8	6.79	.35	4.80	.23	5.67	6 0	....
Cotton seed meal, ...	3	2.75	1.12	.45	.38	2.43	3.9	....
Total, ...	......	24.33	2.29	12.40	.82	16.56	16.5	1:6.2

As the previous ration, it is liable to produce constipation and garget, and, therefore, should have some laxative food substituted for some of the corn stover and corn meal. Ensilage, roots, bran and linseed meal would be good feeds for this purpose.

64.—This ration is fed to the same herd as No. 61:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage,	20	5.58	.22	3.14	.22	3.86	2.0	....
Corn stover,	15	8.99	.30	5.01	.09	5.52	3.8	....
Wheat bran,	6	5.29	.72	2.33	.17	3.44	5.4	....
Gluten meal,	5	4.52	1.28	2.39	.28	4.29	4.5	....
Total,	......	24.38	2.52	12.87	.76	17.11	15.7	1:6.7

This ration is well compounded in every way and under the conditions in which it is fed it might be hard to improve upon it. Presumably, the person using it can readily change it to suit his local conditions from time to time.

65.—The same herd as No. 61:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage,	25	6.98	.23	3.93	.28	4.83	2.5	....
Corn stover,	10	5.99	.20	3.34	.06	3.68	2.5	....
Clover, hay,	3	2.54	.19	1.05	.05	1.35	2.4	....
Wheat bran,	7	6.17	.84	2.72	.20	4.02	6.3	....
Buckwheat middlings,	5	4.34	1.17	1.85	.30	3.71	4.5	....
Total,	......	26.02	2.68	12.89	.89	17.59	18.2	1:5.6

This ration is well balanced in every way, and do not think it advisable to suggest a change.

66.—This ration is fed for the production of butter, to cows weighing 875 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Clover hay, ...	10	8.47	.64	3.49	.16	4.49	4.0	....
Corn stover, ...	12	7.19	.24	4.01	.07	4.42	3.0	....
Buckwheat middlings, ..	3¾	3.26	.89	1.39	.23	2.78	3.4	....
Corn-and-cob meal, ...	2¾	2 33	.12	1.65	.08	1.95	2.1	....
Linseed meal, ...	1½	1.36	.44	.49	.11	1.17	1.8	....
Total, ...	....	22.61	2.33	11.03	.65	14.81	14.3	1:5.4
Ration reduced to 1,000 pound standard, ...	....	25.84	2.66	12 61	.74	16.93	16.3	....

This ration is very well-balanced and would be very hard to improve upon for a dry feed.

67.—This ration is fed to cows weighing 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Timothy hay, ...	10	8.68	.29	4.37	.14	4.98	5.0	....
Ensilage, ...	40	11.16	.44	6.28	.44	7.72	4.0	....
Rutabagas, ...	20	2.28	.20	1.62	.04	1.92	3.0	....
Wheat bran, ...	4	3.52	.48	1.56	.12	2.30	3.6	....
Buckwheat middlings, ..	4	3.47	.95	1.48	.24	2.97	3.6	....
Total, ...	....	29.11	2.36	15.31	.98	19.87	19.2	1 :7.4
Ration reduced to 1,000 pound standard, ...	....	29.86	2.42	15.70	1.01	20.38	19.7	....

This ration should give a large flow of milk of rather inferior quality. Would be well suited for a person selling milk by weight or measure. It contains more digestible matter than the average cow can consume and the nutritive ratio should be narrower. An improvement would be: Ensilage, 35 pounds; timothy hay, 8 pounds; rutabagas, 15 pounds, wheat bran, 4 pounds; buckwheat middlings, 4 pounds.

68.—This ration is fed for butter and milk for family purposes, to cows weighing 800 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay,	5	4.34	.28	2.16	.09	2.84	2.7	....
Corn stover,	12	7.19	.24	4.01	.07	4.42	3.0	....
Corn-and-cob meal,	5½	4.67	.24	3.50	.16	3.90	4.1	....
Oat meal,	1½	1.34	.14	.71	.04	.94	1.7	....
Linseed meal,	1	.91	.29	.33	.07	.78	1.2	....
Wheat bran,	1	.88	.12	.39	.03	.57	.9	....
Total,	....	19.33	1.31	11.10	.46	13.45	13.6	1:9:3
Ration reduced to 1,000 pound standard,	....	24.16	1.64	13.89	.58	18.81	17.0	....

This ration does not contain enough protein, and think the oats had better be exchanged for linseed meal or gluten meal. Mixed hay, 6 pounds; corn stover, 10 or 12 pounds; corn-and-cob meal, 5 pounds; linseed meal, 3 pounds; wheat bran, 1 pound, should give better results than the above.

69.—This ration is fed for butter, to Jersey cows that weigh 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Clover hay,	10	8.47	.64	3.49	.16	4.49	4.0	....
Corn meal,	8	6.80	.44	5.03	.28	6.13	8.0	....
Wheat bran,	12	10.57	1.44	4.67	.35	6.89	10.8	....
Linseed meal,	2	1.82	.59	.65	.14	1.56	2.4	....
Total,	....	27.66	3.11	13.87	.93	19.07	25.2	1:5.1
Ration reduced to 1,000 pound standard,	....	29.22	3.27	14.60	.98	20.07	26.5	....

There are very few cows weighing 950 pounds that would be able to eat and assimilate 22 pounds of grain for any length of time. It would tend to derange the digestive system, as 20 pounds of digestible matter is very heavy feeding and would be too expensive to be practical. A decided improvement would be: Clover hay, 14 pounds; corn meal, 4 pounds; wheat bran, 6 pounds; linseed meal, 2 pounds.

70.—Fed to the same herd as the previous ration:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	10	5 99	.10	3.34	.06	3.68	2.5	....
Corn meal, ...	8	6.80	.44	5.06	.28	6.13	8.0	....
Wheat bran, ...	12	10.57	1.44	4.67	.35	6.89	10.8	....
Cotton seed meal, ...	2	1.84	.74	.30	.25	1.62	2.6	....
Total, ...	......	25.20	2.72	13.37	.94	18.32	23.9	1:5.5
Ration reduced to 1,000 pound standard, ...	....	26.53	2.97	14.07	.99	19.29	25.2	....

This ration illustrates the importance of a person knowing the physiological effect of foods as well as their chemical analysis. As in the previous ration, the amount of grain fed is entirely too heavy and would undoubtedly have an injurious effect upon the digestive apparatus of the animal. It is also very expensive. Corn stover, 8 pounds; clover hay, 8 pounds; corn meal, 4 pounds; wheat bran, 6 pounds; cotton seed meal 1 or 2 pounds, should give better results.

71.—This ration is fed to cows weighing 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	20	5.58	.22	3.14	.22	3.86	2.0	....
Mixed hay, ...	12	8.63	.56	4.72	.18	5.68	5.4	....
Oat straw, ...	6	5.45	.08	2.63	.05	2.84	1.5	....
Wheat bran, ...	4	3.53	.48	1.56	.12	2.30	3.6	....
Linseed meal, ...	3	2.72	.83	.93	.21	2.33	3.6	....
Total, ...	....	25.95	2.22	13.03	.78	17.01	16.1	1:6.7
Ration reduced to 1,000 pound standard, ...	....	27.32	2.34	13.72	.82	17.91	16.9	....

Under some conditions this would be the most economical ration that could be compounded, and without a doubt it is the case with this one. A change in the price of the materials would necessitate a change in the food used. Presumably, the person using this ration is capable of changing it to suit his own local conditions, and needs no suggestions.

72.—The cows receiving this ration weigh about 800 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbbydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	20	17.14	.94	7.86	.30	9.48	9.0	....
Corn stover, ...	6	3.59	.12	2.00	.04	2.21	1.5	....
Corn meal, ...	3	2.55	.17	1.90	.11	2.30	3.0	....
Wheat bran, ...	2	1.76	.24	.78	.06	1.15	1.8	....
Total, ...	....	25.04	1.47	12.54	.51	15.14	15.3	1:9.3
Ration reduced to 1,000 pound standard, ...	....	31.30	1.84	15.63	.64	18.93	19.1	....

This ration would tend to fatten the cows instead of having them produce milk. The nutritive ratio is too wide; the amount of digestible matter is rather heavy, and the proportion between the coarse fodder and grain is not right. With the feeds given it would be impossible to compound a good ration. Some by-products, such as linseed meal, cotton seed meal, gluten meal or buckwheat middlings would have to be added. An improvement would be: Mixed hay, 12 or 14 pounds; corn stover, 6 pounds, corn meal, 2 pounds; wheat bran, 2 pounds; linseed meal or buckwheat middlings, 3 or 4 pounds.

73.—This ration is fed for milk for the city market, to cows that weigh 1,000 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	10	8.57	.47	3.93	.15	4.74	4.5	....
Corn stover, ...	10	5.99	.20	3.34	.06	3.68	2.5	....
Wheat bran, ...	8	7.05	.96	3.11	.23	4.59	7.2	....
Corn-and-cob meal, ...	4	3.40	.18	2.40	.12	2.84	3.0	....
Total, ...	....	25.01	1.81	12.78	.56	15.85	17.2	1:7.6

There are conditions under which this ration might be the best that could be compounded, but should prefer to have more protein in it. If the person using it is not too far from a railroad station, he should buy some by-products, such as mentioned in the previous ration. An improvement would be: Mixed hay, 10 pounds; corn stover, 10 pounds; wheat bran, 4 pounds; corn-and-cob meal, 4 pounds; linseed meal, 3 or 4 pounds; or linseed meal, 2 pounds; cotton seed meal or gluten meal, 1 or 2 pounds.

74.—This ration is fed to the same herd as the previous ration:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	10	8.57	.47	3.93	.15	4.74	4.5	....
Corn stover, ...	10	5.99	.20	3.34	.06	3.68	2.5	....
Wheat bran, ...	8	7.05	.96	3.11	.23	4.59	7.2	....
Corn meal, ...	2	1.70	.11	1.26	.07	1.53	2.0	....
Oat meal, ...	2	1.78	.18	.95	.05	1.25	2.2	....
Total, ...	....	25.09	1.92	12.59	.56	15.79	18.4	1:7.2

This, as the previous ration, should have added to it some of the by-products above mentioned. When not too far from the market, the oats had better be exchanged for some by-product rich in protein. The improvement suggested for the previous ration would answer very well for this one.

75.—The cows to which this ration is fed weigh 1,100 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	45	12.56	.50	7.07	.50	8.69	4.5	....
Corn stover, ...	2½	1.50	.05	.84	.02	.92	.6	....
Wheat bran, ...	3	2.64	.36	1.17	.09	1.72	2.7	....
Total, ...	....	16.70	.91	9.08	.61	11.33	7.8	1:11.5
Ration reduced to 1,000 pound standard, ...	....	15.18	.83	8.25	.55	10.30	7.1	....

This ration is not very much beyond a maintenance ration, that is to say, a cow would need nearly this amount of food to maintain the heat and repair the waste of the body, and, therefore, she could not be expected to produce much milk on this feed. The nutritive ratio is, also, too wide for milk production. An improvement would be: Ensilage, 45 pounds; corn stover, 8 pounds; wheat bran, 3 pounds; cotton seed meal, 3 pounds; linseed meal, gluten meal or dried brewers' grains, 2 or 3 pounds.

76.—The same herd as No. 75:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	10	5.99	.20	3.34	.06	3.68	2.5	....
Mixed hay	4½	3.84	.21	1.77	.07	2.13	2.0	....
Wheat bran, ...	2¼	1.98	.27	.88	.07	1.29	2.0	....
Corn-and-cob meal, ...	4¾	4.03	.21	2.85	.14	3.37	3.6	....
Total, ...	....	15.84	.89	8.84	.34	10.47	10.1	1:10.8
Ration reduced to 1,000 pound standard, ...	....	14.40	.81	8.04	.31	9.52	9.2	....

A cow weighing 1,000 pounds should be able to eat and assimilate nearly twice as much food as this ration calls for. With the feeds given it would be impossible to compound a well-balanced ration. Some of the nitrogenous by-products would have to be added to the ration in order that it might contain the right proportion of milk and heat producing foods. Six pounds more hay, 3 pounds linseed meal and 2 pounds cotton seed meal added would improve it.

77.—The cows receiving this ration weigh about 800 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhy drates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	12	8.68	.56	4.72	.18	5.68	5.4	....
Corn stover, ...	10	5.99	.20	3.34	.06	3.68	2.5	....
Corn-and-cob meal, ...	8	6.79	.35	4.80	.23	5.67	6.0	....
Wheat bran, ...	2½	2.20	.30	.97	.07	1.44	2.3	....
Oat straw, ...	3	2.72	.04	1.32	.03	1.42	.8	....
Total, ...	....	26.38	1.45	15.15	.57	17.89	17.0	1:11.3
Ration reduced to 1,000 pound standard, ...	....	32.98	1.81	18.91	.71	22.36	21.3	....

For an 800 pound cow this ration is too heavy, and the nutritive ratio is too wide. A cow fed on this ration would tend to fatten instead of produce milk. Mixed hay, 8 pounds; corn stover, 8 pounds; oat straw, 3 pounds; corn-and-cob meal, 4 pounds; wheat bran, 2½ pounds; linseed meal, cotton seed meal, gluten meal or buckwheat middlings, 2 or 3 pounds, would be a decided improvement, and should give more economical results.

78.—This ration is fed for milk for the city market, to grade Shorthorn and Holstein cows that weigh 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhy-drates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	9	5.39	.18	3.01	.05	3.31	2.3	....
Corn-and-cob meal, ...	6½	5.52	.29	3.90	.19	4.61	4.9	....
Oat meal, ...	4	3.56	.37	1.89	.10	2.50	4.4	....
Linseed meal, ...	2	1.82	.59	.65	.14	1.56	2.4	....
Total, ...	....	16.29	1.43	9.45	.48	11.98	14.0	1:7.4
Ration reduced to 1,000 pound standard, ...	....	17.15	1.51	9.95	.51	12.61	14.7	....

This ration does not contain enough digestible matter and the nutritive ratio is too wide. An improvement would be: Corn stover, 14 pounds, or corn stover, 8 pounds; clover hay, 6 pounds; corn-and-cob meal, 5 pounds; oat meal, 1 or 2 pounds; linseed meal, 4 pounds.

79.—This ration is fed to the same herd as No. 78:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	9	5.39	.18	3.01	.05	3.31	2.3	....
Clover hay, ...	4	3.39	.26	1.40	.06	1.80	3.2	....
Wheat bran, ...	2	1.76	.24	.78	.06	1.15	1.8	....
Wheat middlings, ...	2	1.76	.26	1.06	.07	1.47	1.9	....
Total, ...	....	12.30	.94	6.25	.24	7.73	9.2	1:7.2
Ration reduced to 1,000 pound standard, ...	....	12.95	.99	6.58	.25	8.14	9.7	....

Presumably, the figures given in this ration is the amount fed twice a day and not the amount fed per day. It is fairly well-balanced, but contains only one-half enough digestible matter. This amount would not be more than a maintenance ration for a 950 pound cow. Corn stover, 14 pounds; clover hay, 8 pounds; wheat bran, 3 pounds; wheat middlings, 3 pounds; linseed meal, 3 pounds; or linseed meal, 1½ pounds; cotton seed meal, 1½ pounds, would be an improvement.

80.—This ration is fed to the same herd as No. 78:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Cardhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	9	5.39	.18	3.01	.05	3.31	2.3	....
Clover hay, ...	4	3.39	.26	1.40	.06	1.80	1.6	....
Linseed meal, ...	1	.91	.29	.33	.07	.78	1.2	....
Wheat bran, ...	2	1.76	.24	.78	.06	1.15	1.8	....
Wheat shorts, ...	2	1.76	.24	1.00	.08	1.42	1.9	....
Total, ...	....	13.21	1.21	6.52	.32	8.46	8.8	1:6.6
Ration reduced to 1,000 pound standard, ...	....	13.91	1.27	6.86	.34	8.90	9.3	....

This ration is well-balanced, but think that it represents only one-half of a day's feed, as there is only a little over half as much digestible matter in it as there should be. If it represents the amount of feed each morning and evening the amount of coarse fodder is larger than most cows will consume. The improvement suggested for the previous ration would do very well for this one.

81.—This ration is fed for the production of milk, to cows weighing 810 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of ration.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Clover hay	10	8.47	.64	3.49	.16	4.49	4.0	....
Corn stover, ...	10	5.99	.20	3.34	.06	3.68	2.5	....
Wheat straw, ...	10	9.04	.06	3.82	.05	3.99	2 5	....
Corn meal, ...	5	4.25	.28	3.16	.18	3.83	5 0	....
Wheat bran, ...	5	4.41	.60	1.95	.15	2.87	4.5	....
Rutabagas, ...	10	1.14	.10	.81	.02	.95	1.5	....
Total, ...	....	33.30	1.88	16.57	.62	19.81	20.0	1:9.6
Ration reduced to 1,000 pound standard, ...	....	41.11	2.32	20.46	.77	24.46	24.2	....

The amount of coarse fodder in this ration is more than we could ever get a cow to eat. There is about 15 pounds more dry matter and 8 pounds more digestible matter than the standard calls for. A cow that could consume and assimilate this amount of food would have to have her digestive apparatus abnormally developed. The nutritive ratio is also too wide. With the feeds given it would be very difficult to compound a well-balanced ration. Clover hay, 6 pounds; corn stover, 6 pounds; wheat straw, 6 pounds; rutabagas, 10 pounds; corn meal, 3 pounds; wheat bran, 2 pounds; linseed meal or cotton seed meal, 3 pounds, would be a decided improvement.

82.—This ration is fed for milk for the city market, to cows weighing 1,000 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn silage, ...	25	6.98	.28	3.93	.28	4.83	2.5	....
Corn stover, ...	10	5.99	.20	3.34	.06	3.68	2.5	....
Clover hay, ...	3	2.54	.19	1.05	.05	1.35	1.2	....
Wheat bran, ...	7	6.17	.84	2.72	.20	4.02	6.3	....
Buckwheat middlings, ..	5	4.34	1.17	1.85	.30	3.71	4.5	....
Total, ...	....	26.02	2.68	12.89	.89	17.59	17.0	1:5.6

This is a very well-balanced ration and would be hard to improve upon. A thing good enough had better be left alone.

83.—This ration is fed to the same herd as the previous one:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Corn stover, ...	12	7.19	.24	4.01	.07	4.42	3.0	....
Oat straw, ...	10	9.08	.14	4.34	.09	4.73	2.5	....
Corn-and-cob meal, ...	4	3.40	.18	2.40	.12	2.84	3.0	....
Cotton seed meal, ...	3	2.75	1.12	.45	.38	2.43	3.9	....
Buffalo gluten meal, ...	5	4.61	.93	2.28	.41	4.12	4.5	....
Total, ...	....	27.03	2.61	13.48	1.07	18.54	16.9	1:6.1

The nutritive raio of this ration is about right, but it contains more digestible matter than the average cow is able to assimilate. It would also tend to cause constipation and garget, as most of the foods given are rather constipating in their effects. If half the amount of corn stover and oats straw could be substituted with 25 pounds ensilage and a pound less each of corn-and-cob meal and gluten meal, the ration would be very materially improved.

84.—This ration is fed for milk, to cows that weigh 1,100 pounds.

	Fresh weight	Dry matter	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	50	13.95	.55	7.85	.55	9.65	5.0	....
Wheat bran, ...	5	4.41	.60	1.95	.15	2.87	4.5	....
Total, ...	......	18.36	1.15	9.80	.70	12.52	9.5	1:9.9
Ration reduced to 1,000 pound standard, ...	....	16.69	1.05	3.91	.64	11.38	8.6	....

This is an exceedingly cheap ration, but there is not enough of it, and the nutritive ratio is too wide. Should think that the milk produced by this ration would be of rather inferior quality. Ensilage, 45 or 50 pounds; corn stover or clover hay, 6 pounds; wheat bran, 3 pounds; linseed meal or gluten meal, 3 pounds; cotton seed meal, 3 pounds, should give better results.

85.—This ratio is fed to cows that weigh 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	2½	2.14	.12	.98	.04	1.19	1.1	....
Corn stover, ...	10	5.99	.20	3.34	.06	3.68	2.5	....
Corn-and-cob meal, ...	10	8.49	.44	6.00	.29	7.09	7.5	....
Wheat shorts, ...	7½	6.62	.92	3.75	.29	5.31	7.1	....
Wheat bran, ...	8	7.05	.96	3.11	.23	4.59	7.2	....
Total, ...	....	30.29	2.64	17.18	.91	21.86	25.4	1:7.3
Ration reduced to 1,000 pound standard, ...	....	31.07	2.71	17.62	.93	22.42	26.1	....

This is an impractical ration, as the amount of grain that it contains would derange the system of any cow in a short time. It is very expensive, contains about 6 pounds more digestible matter than the standard, and the nutritive ratio is too wide. A large part of this ration would pass through the animal without being assimilated.

One of the nitrogenous by-products should be substituted for some of the corn-and-cob meal and wheat shorts. A decided improvement would be: Mixed hay, 6 pounds; corn stover, 10 pounds; corn-and-cob meal, 4 pounds; wheat shorts, 2 pounds; wheat bran, 2 pounds; linseed meal, 3 pounds; or linseed meal, 1½ pounds; cotton seed meal, 1½ pounds.

86.—The cows receiving this ration weigh about 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Ensilage, ...	30	8.37	.33	4.71	.33	5.79	3.0	....
Meadow hay, ...	8	7.29	.38	3.75	.08	4.32	4.0	....
Gluten meal, ...	5	4.52	1.28	2.39	.28	4.29	4.5	....
Total, ...	....	20.18	1.99	10.85	.69	14.40	11.5	1:6.2
Ration reduced to 1,000 pound standard, ...	....	21.24	2.09	11.42	.73	15.16	12.1	....

This ration is very cheap and well-balanced, and would, under most conditions, give very satisfactory results. For some cows a pound more digestible matter would be better. One and one-half pounds linseed meal or cotton seed meal would make up this deficiency.

87.—This ratio is fed to the same cows as the previous one:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Meadow hay, ...	26	23.09	1.25	12.19	.26	14.04	13.0	....
Corn meal, ...	3	2.55	.17	1.90	.11	2.30	3.0	....
Wheat bran, ...	2	1.76	.24	.73	.06	1.15	1.8	....
Total, ...	....	28.00	1.66	14.87	.43	17.49	17.8	1:9.5
Ration reduced to 1,000 pound standard, ...	....	29.48	1.75	15.65	.45	18.41	18.7	....

The amount of hay fed in this ration is very large, more than the average cow could consume. The nutritive ratio is also too wide. Some of the hay should be substituted with some of the nitrogenous by-products mentioned in previous rations. Meadow hay, 20 pounds; corn meal, 3 pounds; wheat bran, 2 pounds; linseed meal, 3 pounds; or linseed meal, 1½ pounds; cotton seed meal, 1 or 1½ pounds, would be an improvement.

88.—Same herd to which the two previous rations were fed:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Green rye,	60	10.80	1.14	5.88	.30	7.68	6.0	....
Wheat bran,	2	1.76	.24	.78	.06	1.15	1.8	....
Mixed hay,	5	4.29	.24	1.97	.08	2.37	2.3	....
Total,	......	16.85	1.62	8.63	.44	11.20	10.1	1:6.0
Ration reduced to 1,000 pound standard,	....	17.74	1.71	9.06	.46	11.79	10.6	....

The amount of digestible matter contained in this ration cannot be determined accurately without knowing the condition of the rye, as to maturity when cut. The nutritive ratio widens as the rye matures. Assuming the rye to be of average maturity, the ration does not contain enough dry and digestible matter. Should think that rye, 60 pounds; mixed hay, 8 pounds; wheat bran, 2 pounds; corn-and-cob meal, 2 or 3 pounds; cotton seed meal or gluten meal, 2 or 3 pounds, would give better results. The ration would cost 5 or 6 cents more, and as to whether the increase in milk and butter would pay for the increase in cost would have to be determined by the person using the ration.

89.—This ration is fed to cows that weigh 1,025 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	15	12.86	.71	5.90	.22	7.11	6.8	....
Corn stover, ...	3	1.80	.06	1.00	.02	1.10	.8	....
Gluten meal, ...	6	5.42	1.54	2.86	.33	5.14	5.4	....
Wheat bran, ...	4	3.52	.48	1.56	.12	2.30	3.6	....
Linseed meal, ...	2	1.82	.59	.65	.14	1.56	2.4	....
Total, ...	....	25.42	3.38	11.97	.84	17.21	19.0	1:4.1
Ration reduced to 1,000 pound standard, ...	....	24.80	3.30	11.68	.82	16.79	18.5	....

The nutritive ratio is very narrow in this ration. It should produce a large quantity of rich milk. It would be a difficult matter to suggest an improvement on this ration.

90.—This ration is fed to cows that weigh 875 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Clover hay, ...	11	9.32	.70	3.84	.18	4.94	4.4	....
Corn meal, ...	6	5.10	.33	3.79	.21	4.60	6.0	....
Ground oats, ...	2	1.78	.18	.95	.05	1.25	2.2	....
Corn stover, ...	10	5.99	.20	3.34	.06	3.68	2.5	....
Total, ...	....	22.19	1.41	11.92	.50	14.47	15.1	1:9.8
Ration reduced to 1,000 pound standard, ...	....	25.36	1.61	13.62	.57	16.54	17.3	....

The grain and coarse fodder is fairly well proportioned and the ration contains about the proper amount of digestible matter. The nutritive ratio is too wide, however, to give the best results in the production of milk and butter. An improvement would be: Clover hay, 10 pounds; corn stover, 10 pounds; corn meal, 5 pounds; linseed meal or gluten meal, 2 pounds; cotton seed meal, 1½ pounds.

91.—This ration is fed to the same herd as No. 90:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	9	7.71	.42	3.54	.14	4.27	4.1	....
Corn stover, ...	10	5.99	.20	3.34	.06	3.68	2.5	....
Corn meal, ...	6	5.10	.33	3.79	.21	4.60	6.0	....
Oat meal, ...	2	1.78	.18	.95	.05	1.25	2.2	....
Total, ...	....	20.58	1.13	11.62	.46	13.80	14.8	1:11.2
Ration reduced to 1,000 pound standard, ...	....	23.52	1.29	13.28	.53	15.77	16.9	....

This ration does not contain enough protein, or the food that produces milk. Some one of the nitrogenous by-products should be substituted for some of the corn meal and oats. Oats, as a rule, is worth more on the market than it is for feeding dairy cattle. Mixed hay, 9 pounds; corn stover, 10 pounds; corn meal, 4 pounds; linseed meal or gluten meal, 3 pounds; cotton seed meal, 2 pounds, would be a decided improvement.

92.—This ration is fed for butter to high grade Jersey cows that weigh 875 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	22	18.85	1.03	8.65	.33	10.43	9.9	....
Gluten meal, ...	3	2.71	.77	1.43	.17	2.57	2.7	....
Potatoes, ...	20	4.22	.18	3.14	....	3.32	5.0	....
Total, ...	....	23.78	1.98	13.22	.50	16.32	17.6	1:7.2
Ration reduced to 1,000 pound standard, ...	....	28.83	2.40	16.03	.61	19.78	21.3	....

This ration contains more digestible matter than the average cow can consume and assimilate. A ration that should give better results would be: Mixed hay, 16 pounds; potatoes, 20 pounds; gluten meal, 5 pounds.

93.—This ration is fed to cows that weigh 1,000 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Clover hay, ...	8	6.78	.51	2.79	.13	3.59	3.2	....
Corn stover, ...	6	3.59	.12	2.00	.04	2.21	1.5	....
Wheat bran, ...	3	2.64	.36	1.17	.09	1.72	2.7	....
Ground oats, ...	1¾	1.56	.16	.83	.05	1.09	1.9	....
Corn meal, ...	5½	4.68	.30	3.48	.19	4.21	5.5	....
Linseed meal, ...	2	1.82	.59	.63	.14	1.56	2.4	....
Total, ...	....	21.07	2.04	10.92	.64	14.38	17.2	1:6.1

This ration is well-balanced, and under some conditions would be the best that could be compounded. The amount of digestible matter is below the standard, but for some cows it would be all right. There might be more coarse fodder fed and less grain, and the oats had better be exchanged for linseed meal, gluten meal, cotton seed meal or brewers' grain.

94.—This ratio is fed for milk, to grade Guernsey and Jersey cows that weigh about 900 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Clover hay, ...	15	12.71	.96	5.24	.24	6.74	6.0	....
Corn and cob meal, ...	5	4.25	.22	3.00	.14	3.55	3.4	....
Wheat middlings, ...	5	4.40	.64	2.66	.17	3.69	4.8	....
Corn stover, ...	5	3.00	.10	1.67	.03	1.84	1.3	....
Total, ...	....	24.36	1.92	12.57	.58	15.82	15.5	1:7.2
Ration reduced to 1,000 pound standard, ...	....	27.07	2.13	13.97	.64	17.58	17.2	....

This is a fairly good ration, but the nutritive ratio is too wide. An improvement would be: Clover hay, 15 pounds; corn stover, 5 pounds; corn-and-cob meal, 4 pounds; wheat middlings, 2 or 3 pounds; linseed meal, 3 pounds; or linseed meal, 1½ pounds; cotton seed meal or gluten meal, 1½ pounds.

95.—This ration is fed for butter, to full blood Devon cows that weigh 1,025 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	16	13.71	.75	6.29	.24	7.58	7.2	....
Corn stover, ...	4	2.40	.08	1.34	.02	1.47	1.0	....
Corn and cob meal, ...	2½	2.12	.11	1.50	.07	1.77	1.9	....
Ground oats, ...	1½	1.34	.14	.71	.04	.94	1.7	....
Wheat bran, ...	2	1.76	.24	.78	.06	1.15	1.8	....
Total, ...	....	21.33	1.32	10.62	.43	12.91	13.6	1:8.8
Ration reduced to 1,000 pound standard, ...	....	20.81	1.29	10.36	.42	12.60	13.3	....

There is only about one-half enough grain in this ration, and the nutritive ratio is too wide. Mixed hay, 16 pounds; corn stover, 4 pounds; corn-and-cob meal, 5 pounds; wheat bran, 3 pounds; linseed meal or buckwheat middlings, 3 pounds; or linseed meal, 1½ pounds; cotton seed meal or gluten meal, 1½ pounds.

96.—This ration is fed for milk for cheese making, to cows weighing 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Clover hay, ...	16	13.55	1.02	5.58	.26	7.18	6.4	....
Barley meal, ...	7	6.24	.61	4.59	.11	5.45	4.9	....
Wheat bran, ...	3	2.64	.36	1.17	.09	1.72	2.7	....
Linseed meal, ...	3	2.72	.88	.98	.21	2.33	3.6	....
Total, ...	....	25.15	2.87	12.33	.67	16.68	17.6	1:4.8
Ration reduced to 1,000 pound standard, ...	....	26.47	3.02	12.97	.71	17.56	18.5	....

The amount of grain fed in this ration is rather heavy, and would prefer to feed about one pound less each of barley meal and wheat bran.

97.—This ration is fed for butter, to cows that weigh 900 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay,	12	8.68	.56	4.72	.18	5.68	5.4	....
Corn meal,	7	5.95	.39	4.42	.25	5.36	7.0	....
Linseed meal,	3	2.72	.88	.98	.21	2.33	3.6	....
Wheat bran,	2	1.76	.24	.78	.06	1.15	1.8	....
Total,	....	19.11	2.07	10.90	.70	14.52	17.8	1:6.0
Ration reduced to 1,000 pound standard,	....	21.23	2.30	12.11	.78	16.13	19.8	....

In seasons when hay is scarce and expensive, this ration would do very well; but when considered only from a chemical standpoint, there should be less grain and more coarse fodder. Presumably, the person using the ration can readily change it to suit his own local conditions and needs no suggestions.

98.—This ration is fed to cows that weigh 925 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay,	18	15.43	.85	7.07	.27	8.53	8.1	....
Corn meal,	4	3.40	.22	2.53	.14	3.06	4.0	....
Oat meal,	4	3.56	.37	1.89	.10	2.51	4.4	....
Potatoes,	18	3.80	.16	2.83	.00	2.99	4.5	....
Total,	....	26.19	1.60	14.32	.51	17.09	21.0	1:9.7
Ration reduced to 1,000 pound standard,	....	28.32	1.73	15.48	.55	18.42	22.7	....

This ration is rather heavy and the nutritive ratio is too wide. Some one of the nitrogenous by-products should be substituted for some of the grain fed. Mixed hay, 18 pounds; potatoes, 20 pounds; corn meal, 3 pounds; oat meal, 1 pound; linseed meal, 2 pounds; cotton seed meal or gluten meal, 1 pound.

99.—This ration is fed to the same herd as the previous ration:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay,	18	15.43	.85	7.07	.27	8.53	8.1	....
Ground buckwheat,	4	3.51	.31	2.03	.07	2.50	4.0	....
Ground oats,	4	3.56	.37	1.89	.10	2.51	4.4	....
Potatoes,	20	4.22	.18	3.14	.00	3.32	5.0	....
Total,	....	26.72	1.71	14.13	.44	16.86	21.5	1:8.8
Ration reduced to 1,000 pound standard,	....	28.89	1.85	15.28	.48	18.23	23.2	....

This ration is heavier than the average cow is capable of assimilating, and does not contain enough protein. Mixed hay, 14 pounds; potatoes, 20 pounds; buckwheat middlings, 4 pounds; ground oats, 4 pounds; or substitute for the oats, wheat, bran or middlings, 2 pounds; corn meal, 2 pounds, should be an improvement. The buckwheat middlings contain more protein than does the whole grain. Buckwheat flour is composed largely of starch and produces heat and fat in the animal body. Therefore, the flour had better be sold and only the middlings retained for feeding.

100.—This ration is fed for butter, to cows that weigh 900 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay,	25	21.43	1.18	9.83	.38	11.85	11.3	....
Corn meal,	8	6.80	.44	5.06	.28	6.13	8.0	....
Ground oats,	4	3.56	.37	1.89	.10	2.51	4.4	....
Total,	....	31.79	1.99	16.78	.76	20.49	23.7	1:9.3
Ration reduced to 1,000 pound standard,	....	35.32	2.21	18.64	.84	22.77	26.3	....

This ration contains about 6½ pounds more digestible matter than the standard; the nutritive ratio is too wide and is entirely too expensive to be practical. A decided improvement would be the fol-

lowing: Mixed hay, 18 pounds; corn meal, 5 pounds; ground oats or wheat bran, 2 pounds; linseed meal, 3 pounds; or linseed meal, 1½ pounds; cotton seed meal or gluten meal, 1½ pounds.

101.—This ration is fed for milk for a cheese factory, to cows that weigh 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Timothy hay, ...	15	9.02	.44	6.56	.21	7.47	7.5	....
Ground barley, ...	5	4.46	.44	3.28	.08	3.90	3.5	....
Corn and cob meal, ...	5	4.25	.22	3.00	.15	3.55	3.8	....
Total, ...	....	17.73	1.10	12.84	.44	14.92	14.8	1:12.6
Ration reduced to 1.000 pound standard, ...	....	18.66	1.16	13.52	.46	15.71	15.6	....

There is very little protein in this ration and the tendency would be to fatten cows instead of have them produce milk. With the feeds given it would be impossible to compound a well-balanced ration. Clover hay is very much better for the production of milk than is timothy hay. In order to balance the ration there would have to be added some of the nitrogenous by-products mentioned in previous rations. Timothy hay, 15 pounds; ground barley, 3 pounds; corn-and-cob meal, 3 pounds; linseed meal, 4 pounds; or linseed meal, 2½ pounds; cotton seed meal of gluten meal, 1½ pounds, would greatly improve the ration. If ensilage could be used it would also materially improve the ration.

102.—This ration is fed to cows that weigh 950 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	15	12.83	.71	5.90	.23	7.11	6.8	....
Corn stover, ...	5	3.00	.10	1.67	.03	1.84	1.3	....
Corn and cob meal, ...	7¼	6.16	.32	4.35	.21	5.14	5.4	....
Wheat bran, ...	2	1.76	.24	.78	.06	1.15	1.8	....
Total, ...	....	23.78	1.37	12.70	.53	15.24	15.3	1:10.1
Ration reduced to 1,000 pound standard, ...	....	25.03	1.44	13.37	.56	16.04	16.1	....

The amount of digestible matter in this ration is about right, but the nutritive ratio is too wide. A decided improvement would be: Mixed hay, 15 pounds; corn stover, 7 pounds; corn-and-cob meal, 4 pounds; wheat bran, 2 pounds; linseed meal, 3 pounds; or linseed meal, 1½ pounds; cotton seed meal or gluten meal, 1½ pounds.

103.—The cows receiving this ration weigh 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	16	13.71	.75	6.29	.24	7.58	7.2	....
Corn stover, ...	5	3.00	.10	1.67	.03	1.84	1.3	....
Wheat chaff, ...	2	1.81	.06	.47	.01	.56	.5	....
Wheat middlings, ...	4½	3.96	.58	2.39	.15	3.32	4.3	....
Wheat bran, ...	4	3.52	.48	1.56	.12	2.30	3.6	....
Total, ...	....	26.00	1.97	12.38	.55	15.60	16.9	1:6.9
Ration reduced to 1,000 pound standard, ...	....	26.67	2.02	12.70	.56	16.00	17.3	....

This ration is well-balanced and compares well with the so-called "American Standard." Recent experiments indicate that a narrower ratio than this is at times advisable. Two pounds of linseed meal, cotton seed meal or gluten meal substituted for a pound each of wheat bran and wheat middlings would, in some cases, be an improvement.

104.—The cows receiving this ration weigh 975 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Timothy hay, ...	18	15.62	.52	7.87	.25	8.96	9.0	....
Corn meal, ...	2½	2.13	.14	1.58	.09	1.92	2.5	....
Ground oats, ...	2½	2.23	.23	1.18	.07	1.56	2.8	....
Mangolds, ...	15	1.37	.17	.81	.00	.98	1.5	....
Total, ...	....	21.35	1.06	11.44	.41	13.42	15.8	1:11.7
Ration reduced to 1,000 pounds standard, ...	....	21.90	1.09	11.73	.42	13.77	16.2	....

There is not enough of grain in this ration and the nutritive ratio is too wide to secure the best results. A few pounds of mangolds as this ration contains are very useful in winter dairying when no other succulent food, such as ensilage, can be secured. Ensilage is preferable to roots, as it can be grown at very much less per pound of digestible food. An improvement would be: Timothy hay, 16 pounds; or timothy hay, 8 pounds; clover hay, 8 pounds; mangolds, 15 pounds; corn meal, 3 pounds; ground oats or wheat bran, 3 pounds; cotton seed meal, 3 pounds.

105.—The cows receiving this ration weigh 985 pounds:

	Fresh weight	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
			Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Mixed hay, ...	10	8.57	.47	3.93	.15	4.74	4.5	....
Corn stover, ...	6	3.59	.12	2.00	.04	2.21	1.5	....
Corn meal, ...	7	5.95	.39	4.42	.25	5.36	7.0	....
Wheat bran, ...	4	3.52	.48	1.56	.12	2.30	3.6	....
Total, ...	....	21.63	1.46	11.91	.56	14.61	16.6	1:9.0
Ration reduced to 1,000 pounds standard	....	21.96	1.48	12.09	.57	14.83	16.9	....

The nutritive ratio in this ration it too wide, and for the average cow it might contain 1 or 2 pounds more digestible matter. Some nitrogenous by-products should be substituted for some of the corn meal. Mixed hay, 10 pounds; corn stover, 6 or 8 pounds; corn meal, 4 pounds; wheat bran, 4 pounds; cotton seed meal or linseed meal, 3 pounds; or cotton seed meal, 1½ pounds; linseed meal, 1½ pounds, should give better results.

GENERAL SUMMARY.

In a subjoined table will be given the weights of the different foods as used in the different rations, and also the improved ration as recommended by the writer. There will undoubtedly be circumstances where the recommended ration will not be practicable on account of local conditions that the writer was not familiar with. In all cases it was the aim to make as little change as possible, and trust that on the whole, the rations will be satisfactory. These rations will have to be changed from time to time as the availability and price of the materials change. As a rule, the rations as used do not contain enough of protein, and I think that the dairymen of the State would do well to use more of the nitrogenous by-products, such as linseed meal, cotton seed meal, gluten meal, brewers' grains, malt sprouts, buckwheat middlings, etc., than they have heretofore.

COMPONENTS OF PENNSYLVANIA RATIONS FOR DAIRY COWS.

Ration No.	1		2		3		4		5		6	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal,	......	......	......	......	......	......	......	......	......	......	......	......
Barley meal,	......	......	......	......	......	......	......	......	......	......	......	......
Brewers' grains, wet,	......	......	10	10	......	......	......	......	......	......	......	......
Brewers' grains, dry,	......	......	......	......	......	......	......	......	......	......	......	......
Buckwheat middlings,	......	......	......	......	......	......	......	......	6	6	......	3
Buckwheat (ground),	......	......	......	......	......	......	......	......	......	......	......	......
Buffalo gluten feed,	......	......	......	......	......	......	......	......	......	......	......	......
Cerealine feed,	......	......	......	......	......	......	......	......	......	......	......	......
Corn meal,	2	2	3	2	5	4	......	......	......	......	......	......
Corn and cob meal,	......	......	......	......	......	......	6	5	......	......	......	......
Corn stover,	......	......	......	......	......	......	......	......	......	......	......	......
Corn ensilage,	50	50	30	30	......	......	......	......	45	45	40	40
Clover hay,	8	8	......	......	......	......	......	......	5	5	5	5
Cotton seed meal,	......	2½	......	1	......	......	......	......	......	......	......	2
Chicago gluten meal,	......	......	......	......	......	......	......	......	......	......	......	......
Germ meal,	......	......	......	......	......	......	......	......	......	......	......	......
Gluten meal,	......	......	......	......	......	......	2	2	......	......	......	......
Hominy chop,	......	......	......	......	......	......	......	......	......	......	......	......
Linseed meal,	......	......	......	......	......	2	......	......	......	......	......	......
Mixed hay,	......	......	10	8	20	10	20	18	......	......	......	......
Malt sprouts,	......	......	......	......	......	......	......	......	......	......	......	......
Meadow hay,	......	......	......	......	......	......	......	......	......	......	......	......
Mangolds,	......	......	......	......	......	......	......	......	......	......	......	......
Millet hay,	......	......	......	......	......	......	......	......	......	......	......	......
Oats (grain ground),	......	......	......	......	3	......	......	......	......	......	......	......
Oats, straw,	......	......	......	......	4	4	......	......	......	......	......	......
Potatoes,	......	......	......	......	......	......	......	......	......	......	......	......
Rutabagas,	......	......	......	......	......	......	......	......	......	......	......	......
Rye straw,	......	......	......	......	......	......	......	......	......	......	......	......
Rye, green,	......	......	......	......	......	......	......	......	......	......	......	......
Skimmed milk,	......	......	......	......	......	......	......	......	......	......	......	......
Timothy hay,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat bran,	6	6	7	4	......	2	6	5	......	......	......	......
Wheat chaff,	......	......	......	......	3	3	......	......	......	......	......	......
Wheat middlings,	......	......	......	......	......	......	......	......	......	......	6	3
Wheat shorts,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat straw,	......	......	......	......	......	......	......	......	......	......	......	......

COMPONENTS OF PENNSYLVANIA RATIONS FOR DAIRY COWS—*Continued.*

Ration No.	7		8		9		10		11		12	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal,	......	......	......	......	......	......	......	......	......	......	......	......
Barley meal,	......	......	......	......	......	......	......	......	......	......	......	......
Brewers' grains, wet,	......	......	......	......	......	......	......	......	......	......	......	......
Brewers' grains, dry,	......	......	......	......	......	......	......	......	......	......	......	......
Buckwheat middlings,	......	......	......	......	......	......	......	......	......	......	......	......
Buckwheat (ground),	......	......	......	......	......	......	......	......	......	......	......	......
Buffalo gluten feed,	......	......	......	......	......	......	......	......	......	......	......	......
Cerealine feed,	......	......	......	......	......	......	......	......	......	......	......	......
Corn meal,	......	......	1½	3	1½	3	2	2	......	......	......	......
Corn and cob meal,	......	......	......	......	......	......	......	......	......	......	6	6
Corn stover,	......	......	8½	16	8½	16	8	12	12	8	5½	5½
Corn ensilage,	50	40	......	......	......	......	......	......	15	15	......	......
Clover hay,	2	8	......	......	......	......	7	9	12	10	......	......
Cotton seed meal,	1	2	......	......	1½	3	......	......	......	......	......	......
Chicago gluten meal,	......	......	......	......	......	......	......	......	......	......	......	......
Germ meal,	......	......	......	......	......	......	......	......	......	......	......	......
Gluten meal,	......	......	......	......	......	......	2¾	2¾	8	5	......	......
Hominy chop,	......	......	......	......	......	......	......	......	......	......	......	......
Linseed meal,	......	......	2	4	1	2	......	......	......	......	2	2
Mixed hay,	......	......	......	......	......	......	......	......	......	......	......	......
Malt sprouts,	......	......	......	......	......	......	......	......	......	......	......	......
Meadow hay,	......	......	......	......	......	......	......	......	......	......	8½	8½
Mangolds,	......	......	......	......	......	......	......	......	......	......	......	......
Millet hay,	......	......	......	......	......	......	......	......	......	......	......	......
Oats (grain ground),	......	......	1	......	2	......	1½	1½	......	......	......	......
Oats, straw,	......	......	......	......	......	......	......	......	......	......	......	......
Potatoes,	......	......	......	......	......	......	......	......	......	......	......	......
Rutabagas,	......	......	......	......	......	......	......	......	......	......	......	......
Rye straw,	......	......	......	......	......	......	......	......	......	......	......	......
Rye, green,	......	......	......	......	......	......	......	......	......	......	......	......
Skimmed milk,	......	......	......	......	......	......	......	......	......	......	8	8
Timothy hay,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat bran,	7	7	3	6	2	4	3¾	3¾	8	5	2	2
Wheat chaff,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat middlings,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat shorts,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat straw,	......	......	......	......	......	......	......	......	......	......	......	......

Components of Pennsylvania Rations for Dairy Cows—*Continued.*

Ration No.	13		14		15		16		17		18	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barley meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brewers' grains, wet,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brewers' grains, dry,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buckwheat middlings,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buckwheat (ground),	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buffalo gluten feed,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cerealine feed,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Corn meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Corn and cob meal,	.....	.....	.....	.....	5½	5½	2½	2½	4	4	4	4
Corn stover,	10	10	12	8	6	6	.....	.....	5	5	5	5
Corn ensilage,	35	35	.....	20	.....	.....	.....	.....	.....	.....	.....	.....
Clover hay,	10	10	10	6	.....	.....	.....	.....	.....	.....	.....	.....
Cotton seed meal,	4	4	2½	2¼	.....	.....	.....	.....	.....	.....	.....	.....
Chicago gluten meal,	.....	.....	4	4	.....	.....	.....	.....	.....	.....	.....	.....
Germ meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Gluten meal,	.....	.....	.....	.....	.....	.....	5½	5½	.....	.....	.....	.....
Hominy chop,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Linseed meal,	.....	.....	.....	.....	.....	2	.....	.....	.....	2	2	2
Mixed hay,	.....	.....	.....	.....	14	10	16	16	12	10	12	12
Malt sprouts,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Meadow hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mangolds,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Millet hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oats (grain ground),	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	.....	.....
Oats, straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Potatoes,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rutabagas,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rye straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rye, green,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Skimmed milk,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Timothy hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat bran,	.....	.....	.....	.....	3	3	2	2	2	2	2	2
Wheat chaff,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat middlings,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat shorts,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

COMPONENTS OF PENNSYLVANIA RATIONS FOR DAIRY COWS—*Continued.*

Ration No.	19		20		21		22		23		24	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal,	......	......	......	......	......	......	......	......	......	......	......	......
Barley meal,	......	......	......	......	......	......	......	......	......	......	......	......
Brewers' grains, wet,	......	......	......	......	......	......	......	......	......	......	......	......
Brewers' grains, dry,	......	......	......	......	......	......	......	......	......	......	......	......
Buckwheat middlings,	......	......	......	......	......	......	......	......	......	......	......	......
Buckwheat (ground),	......	......	......	......	......	......	......	......	......	......	......	......
Buffalo gluten feed,	......	......	......	......	......	......	......	......	......	......	......	......
Cerealine feed,	......	......	......	......	......	......	......	......	......	......	......	......
Corn meal,	4	3	......	......	......	......	10	4	6	5	3	3
Corn and cob meal,	......	......	3⅓	3⅓	......	......	......	......	......	......	......	......
Corn stover,	4	4	......	......	8	6	6	7	5	8	5	8
Corn ensilage,	20	20	64	45	......	20	......	......	......	......	......	......
Clover hay,	......	......	......	......	......	......	......	......	......	......	......	......
Cotton seed meal,	1	2	......	......	2	2	......	......	......	......	3	3
Chicago gluten meal,	......	......	......	......	......	......	......	......	......	......	......	......
Germ meal,	......	......	......	......	......	......	......	......	......	......	......	......
Gluten meal,	......	......	......	......	4	3	......	......	......	......	......	......
Hominy chop,	......	......	......	......	......	......	......	......	......	......	......	......
Linseed meal,	......	......	3⅓	3⅓	1½	1½	......	2	......	2	......	......
Mixed hay,	8	8	......	......	6	4	6	7	6	9	6	9
Malt sprouts,	......	......	......	......	......	......	......	......	......	......	......	......
Meadow hay,	......	......	......	......	......	......	......	......	......	......	......	......
Mangolds,	......	......	......	......	......	......	......	......	......	......	......	......
Millet hay,	......	......	......	......	......	......	......	......	......	......	......	......
Oats (grain ground),	......	......	......	......	......	......	......	......	......	......	......	......
Oats, straw,	......	......	......	......	......	......	......	......	......	......	......	......
Potatoes,	......	......	......	......	......	......	......	......	......	......	......	......
Rutabagas,	......	......	......	......	......	......	......	......	......	......	......	......
Rye straw,	......	......	......	......	......	......	......	......	......	......	......	......
Rye, green,	......	......	......	......	......	......	......	......	......	......	......	......
Skimmed milk,	......	......	......	......	......	......	......	......	......	......	......	......
Timothy hay,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat bran,	4	4	3⅓	3⅓	3	2	4	2	6	6	6	5
Wheat chaff,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat middlings,	......	......	......	......	......	......	8	4	......	......	......	......
Wheat shorts,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat straw,	......	......	......	......	......	......	......	......	......	......	......	......

COMPONENTS OF PENNSYLVANIA RATIONS FOR DAIRY COWS—*Continued.*

Ration No.	25		26		27		28		29		30	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal, ...	......	......	......	......	......	......	......	......	......	......	......	......
Barley meal, ...	......	......	......	......	......	......	......	......	......	......	......	......
Brewers' grains, wet, ...	......	......	......	......	......	......	......	......	......	......	......	......
Brewers' grains, dry, ...	......	......	......	......	......	......	......	......	......	......	......	......
Buckwheat middlings, ...	2	4	......	......	......	......	......	......	......	......	......	......
Buckwheat (ground), ...	......	......	......	......	......	......	......	......	......	......	......	......
Buffalo gluten feed, ...	......	......	......	......	......	......	......	......	......	......	......	......
Cerealine feed, ...	......	......	......	......	......	......	......	......	......	......	......	......
Corn meal, ...	2	2	3½	2	4	2	......	......	4	3	7	4
Corn and cob meal, ...	......	......	......	......	......	......	......	......	......	......	......	......
Corn stover, ...	......	......	6	8	6	8	......	......	......	......	3	6
Corn ensilage, ...	33	33	......	......	......	......	50	40	25	25	......	......
Clover hay, ...	......	......	......	......	......	......	......	......	......	......	......	......
Cotton seed meal, ...	......	......	3	2	......	......	......	......	......	2	......	....
Chicago gluten meal, ...	......	......	......	......	......	......	......	......	......	......	......	......
Germ meal, ...	......	......	......	......	......	......	......	......	......	......	......	......
Gluten meal, ...	......	......	2½	2½	......	......	8	8	......	......	......	......
Hominy chop, ...	......	......	......	......	......	......	......	......	......	......	......	......
Linseed meal, ...	......	......	......	......	3	3	......	......	......	2	......	3
Mixed hay, ...	11	11	3	6	3	8	8	8	......	......	10	10
Malt sprouts, ...	......	......	......	......	......	......	......	......	......	......	......	......
Meadow hay, ...	......	......	......	......	......	......	......	......	......	......	......	......
Mangolds, ...	......	......	......	......	......	......	......	......	......	......	......	......
Millet hay, ...	......	......	......	......	......	......	......	......	5	5	......	......
Oats (grain ground), ...	......	......	......	......	......	......	......	......	2	1	......	......
Oats, straw, ...	......	......	......	......	......	......	......	......	......	......	......	......
Potatoes, ...	......	......	......	......	......	......	......	......	......	......	......	......
Rutabagas, ...	......	......	......	......	......	......	......	......	......	......	......	......
Rye straw, ...	......	......	......	......	......	......	......	......	......	......	......	......
Rye, green, ...	......	......	......	......	......	......	......	......	......	......	......	......
Skimmed milk, ...	......	......	......	......	......	......	......	......	......	......	......	......
Timothy hay, ...	......	......	......	......	......	......	......	......	5	3	......	......
Wheat bran, ...	3	1	......	......	......	......	......	......	......	......	2½	2½
Wheat chaff, ...	......	......	......	......	......	......	......	......	......	......	......	......
Wheat middlings, ...	......	......	3	3	4½	4	......	......	......	......	......	......
Wheat shorts, ...	......	......	......	......	......	......	......	......	......	......	......	......
Wheat straw	......	......	......	......	......	......	......	......	......	......	......	......

COMPONENTS OF PENNSYLVANIA RATIONS FOR DAIRY COWS—*Continued.*

Ration No.	31		32		33		34		35		36	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barley meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brewers' grains, wet,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brewers' grains, dry,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buckwheat middlings,	.....	.....	.....	.....	.....	.....	3¼	3¼	.....	.....	.....	.....
Buckwheat (ground),	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buffalo gluten feed,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cerealine feed,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Corn meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Corn and cob meal,	3	3	5	4	.....	.....	4½	3	3¼	3¼	2	2
Corn stover,	9	9	7	8	.....	.....	5	5	9½	9	8	8
Corn ensilage,	50	35	19	25	.....	.....	.....	.....	.....	.....	.....	.....
Clover hay,	.....	.....	.....	.....	15	12	.....	.....	.....	.....	.....	.....
Cotton seed meal,	.....	3	.....	3	.....	.....	.....	.....	.....	.....	.....	.....
Chicago gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Germ meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hominy chop,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Linseed meal,	1	1	.....	.....	.....	2	2	2	1	1	.....	2½
Mixed hay,	.....	.....	.....	.....	.....	.....	.....	.....	14	10	.....	.....
Malt sprouts,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Meadow hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8	8
Mangolds,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Millet hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oats (grain ground),	.....	.....	.....	.....	6	4	.....	.....	2½	2½	.....	.....
Oats, straw,	.....	.....	.....	.....	6	6	.....	.....	.....	.....	.....	.....
Potatoes,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rutabagas,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rye straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rye, green,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Skimmed milk,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Timothy hay,	.....	.....	.....	.....	.....	.....	12	10	.....	.....	.....	.....
Wheat bran,	2	2	5	3	.....	.....	.....	.....	2	2	3	3
Wheat chaff,	.....	.....	.....	.....	.....	.....	3	3	.....	.....	.....	.....
Wheat middlings,	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....
Wheat shorts,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Components of Pennsylvania Rations for Dairy Cows—*Continued.*

Ration No.	37		38		39		40		41		42	
FEEDING STUFFS.	Original ration.	**Improved ration.**	Original ration.	**Improved ration.**	Original ration.	**Improved ration.**	Original ration.	**Improved ration.**	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs	Lbs.
Atlas gluten meal,											4	4
Barley meal,												
Brewers' grains, wet,												
Brewers' grains, dry,												
Buckwheat middlings,												
Buckwheat (ground),												
Buffalo gluten feed,												
Cerealine feed,												
Corn meal,												
Corn and cob meal,	6	4	4	4	4	2					8	8
Corn stover,	20	16	13	10			20	12			10	10
Corn ensilage,						25			40	35		
Clover hay,				5	12	12						5
Cotton seed meal,		1½										
Chicago gluten meal,												
Germ meal,												
Gluten meal,							10	5	4	4		
Hominy chop,												
Linseed meal,		1½	2	2	2	2			2	2	1½	1½
Mixed hay,							10	5				
Malt sprouts,												
Meadow hay,												
Mangolds,												
Millet hay,												
Oats (grain ground),	3	2										
Oats, straw,			3	3		3						
Potatoes,												
Rutabagas,	10	10										
Rye straw,												
Rye, green,												
Skimmed milk,												
Timothy hay,									12	10		
Wheat bran,			4	4	4	4	2	3	6	4		
Wheat chaff,												
Wheat middlings,												
Wheat shorts,												
Wheat straw,												

COMPONENTS OF PENNSYLVANIA RATIONS FOR DAIRY COWS—*Continued.*

Ration No.	43		44		45		46		47		48	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs.
Atlas gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barley meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brewers' grains, wet,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brewers' grains, dry,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buckwheat middlings,	.....	.....	1	3	.....	.....	.....	.....	.....	.....	.....	.....
Buckwheat (ground),	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buffalo gluten feed,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cerealine feed,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Corn meal,	5	2	.....	.....	4	4	4	2	2½	2½	.....	.....
Corn and cob meal,	.....	.....	6	4	.....	.....	.....	.....	.....	.....	12	6
Corn stover,	.....	.....	.....	.....	5	8	6	6	.....	.....	.....	.....
Corn ensilage,	.....	.....	38	38	.....	.....	37	37	.....	.....	.....	.....
Clover hay,	.....	.....	.....	5	.....	.....	.....	.....	.....	.....	.....	.....
Cotton seed meal,	.....	2	.....	.....	.....	.....	.....	2	.....	.....	.....	.....
Chicago gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Germ meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	5	5	.....	.....
Hominy chop,	3	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Linseed meal,	.....	2	.....	.....	.....	3	.....	2	.....	.....	3	3
Mixed hay,	10	16	.....	.....	10	10	.....	.....	20	20	15	16
Malt sprouts,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Meadow hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mangolds,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Millet hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oats (grain ground),	.....	.....	1	1	3	.....	.....	.....	.....	.....	.....	.....
Oats, straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Potatoes,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rutabagas,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rye straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rye, green,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Skimmed milk,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Timothy hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat bran,	4	2	1	1	3	3	5	3	2½	2½	3	2
Wheat chaff,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat middlings,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat shorts,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

COMPONENTS OF PENNSYLVANIA RATIONS FOR DAIRY COWS—*Continued.*

Ration No.	49		50		51		52		53		54	
FEEDING STUFFS.	Original ration.	**Improved ration.**	Original ration.	**Improved ration.**	Original ration.	**Improved ration.**	Original ration.	**Improved ration.**	Original ration.	**Improved ration.**	Original ration.	**Improved ration.**
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal,											4	4
Barley meal,												
Brewers' grains, wet,												
Brewers' grains, dry,												
Buckwheat middlings,					3	3						
Buckwheat (ground),												
Buffalo gluten feed,												
Cerealine feed,									4	4		
Corn meal,			4	3			5	4				
Corn and cob meal,	2	2										
Corn stover,	10	10					10	8				
Corn ensilage,					33⅓	33⅓			30	30	30	30
Clover hay,	12	12	18	15								
Cotton seed meal,					2	2		1	2	2	2	2
Chicago gluten meal,												
Germ meal,												
Gluten meal,		2	4	3								
Hominy chop,												
Linseed meal,		2						2				
Mixed hay,					8	8	10	8	8	8	8	8
Malt sprouts,												
Meadow hay,												
Mangolds,												
Millet hay												
Oats (grain ground),							3					
Oats, straw,												
Potatoes,			7	7								
Rutabagas,												
Rye straw,					8¾	8¾						
Rye, green,												
Skimmed milk,												
Timothy hay,	8											
Wheat bran,	4	4	4	2					4	4	4	4
Wheat chaff,												
Wheat middlings,								1				
Wheat shorts,												
Wheat straw,												

COMPONENTS OF PENNSYLVANIA RATIONS FOR DAIRY COWS—*Continued.*

Ration No.	55		56		57		58		59		60	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal,	......	......	......	......	......	......	......	......	......	......	......	......
Barley meal,	......	......	......	......	......	......	......	......	......	......	......	......
Brewers' grains, wet,	......	......	......	......	......	......	......	......	......	......	......	......
Brewers' grains, dry,	......	......	......	......	......	......	......	......	......	......	......	......
Buckwheat middlings,	......	......	......	......	......	......	......	......	......	......	......	......
Buckwheat (ground),	......	......	......	......	......	......	......	......	......	......	......	......
Buffalo gluten feed,	......	......	......	......	......	......	......	......	......	......	......	......
Cerealine feed,	......	......	......	......	......	......	......	......	......	......	......	......
Corn meal,	......	......	......	......	5	4	2½	2½	......	......	......	......
Corn and cob meal,	4	4	8	6	......	......	......	......	7	3	......	......
Corn stover,	......	......	18	14	6	8	......	......	......	......	......	......
Corn ensilage,	40	40	......	......	......	......	......	......	......	......	35	35
Clover hay,	......	5	......	6	......	......	......	......	......	......	......	6
Cotton seed meal,	......	2	......	2	......	......	1½	1½	......	......	......	2
Chicago gluten meal,	......	......	......	......	......	......	......	......	......	......	......	......
Germ meal,	......	......	......	......	......	......	......	......	......	......	......	......
Gluten meal,	......	......	......	......	......	......	......	......	......	......	......	......
Hominy chop,	......	......	......	......	......	......	......	......	......	......	......	......
Linseed meal,	......	......	1½	2	......	3	......	......	1	3	......	......
Mixed hay,	......	......	......	......	4	6	20	20	12	18	......	......
Malt sprouts,	......	......	......	......	......	......	......	......	......	......	......	......
Meadow hay,	......	......	......	......	......	......	......	......	......	......	......	......
Mangolds,	......	......	......	......	......	......	......	......	......	......	......	......
Millet hay,	......	......	......	......	......	......	......	......	......	......	......	......
Oats (grain ground),	2	......	......	......	3	......	......	......	......	......	......	......
Oats, straw,	......	......	......	......	......	......	......	......	......	......	......	......
Potatoes,	......	......	......	......	10	10	......	......	......	......	......	......
Rutabagas,	......	......	......	......	......	......	......	......	......	......	......	......
Rye straw,	......	......	......	......	......	......	......	......	......	......	......	......
Rye, green,	......	......	......	......	......	......	......	......	......	......	......	......
Skimmed milk,	......	......	......	......	......	......	......	......	......	......	......	......
Timothy hay,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat bran,	8	4	3	3	4	4	5½	5½	3	3	8	8
Wheat chaff,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat middlings,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat shorts,	......	......	......	......	......	......	......	......	......	......	......	......
Wheat straw,	......	......	......	......	......	......	......	......	......	......	......	......

Components of Pennsylvania Rations for Dairy Cows—*Continued.*

Ration No.	61		62		63		64		65		66	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.
Atlas gluten meal,												
Barley meal,												
Brewers' grains, wet,												
Brewers' grains, dry,												
Buckwheat middlings,									5	5	3¾	3¾
Buckwheat (ground),												
Buffalo gluten feed,												
Cerealine feed,												
Corn meal,	3½	3½	8	8								
Corn and cob meal,					8	8					2¾	2¾
Corn stover,	12	12	18		12	12	15	15	10	10	12	12
Corn ensilage,				35			20	20	25	25		
Clover hay,			6	6	9	9			3	3	10	10
Cotton seed meal,			3	3	3	3						
Chicago gluten meal,												
Germ meal,							5	5				
Gluten meal,												
Hominy chop,											1½	1½
Linseed meal,	4	4										
Mixed hay,	9	9										
Malt sprouts,												
Meadow hay,												
Mangolds,												
Millet hay,	3½											
Oats (grain ground),												
Oats, straw,												
Potatoes,												
Rutabagas,												
Rye straw,												
Rye, green,												
Skimmed milk,												
Timothy hay,												
Wheat bran,		3½					6	6	3	3		
Wheat chaff,												
Wheat middlings,												
Wheat shorts,												
Wheat straw,												

Components of Pennsylvania Rations for Dairy Cows—*Continued.*

Ration No.	67		68		69		70		71		72	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barley meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brewers' grains, wet,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brewers' grains, dry,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buckwheat middlings,	4	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Buckwheat (ground),	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buffalo gluten feed,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cerealine feed,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Corn meal,	.....	.....	.....	.....	8	4	8	4	.....	.....	3	2
Corn and cob meal,	.....	.....	5½	5	.....	.....	.....	.....	.....	.....	.....	.....
Corn stover,	.....	.....	12	12	.....	.....	10	8	.....	.....	6	6
Corn ensilage,	40	35	.....	.....	.....	.....	.....	.....	20	20	.....	.....
Clover hay,	.....	.....	.....	.....	10	14	.....	8	.....	.....	.....	.....
Cotton seed meal,	.....	.....	.....	.....	.....	.....	2	2	.....	.....	.....	.....
Chicago gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Germ meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hominy chop,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Linseed meal,	.....	.....	1	3	2	2	.....	.....	3	3	.....	2
Mixed hay,	.....	.....	6	6	.....	.....	.....	.....	12	12	20	12
Malt sprouts,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Meadow hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mangolds,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Millet hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oats (grain ground),	.....	.....	1½	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oats, straw,	.....	.....	.....	.....	.....	.....	.....	.....	6	6	.....	.....
Potatoes,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rutabagas,	20	15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rye straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rye, green,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Skimmed milk,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Timothy hay,	10	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat bran,	4	4	1	1	12	6	12	6	4	4	2	2
Wheat chaff,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat middlings,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat shorts,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

COMPONENTS OF PENNSYLVANIA RATIONS FOR DAIRY COWS—*Continued.*

Ration No.	73		74		75		76		77		78	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal,												
Barley meal,												
Brewers' grains, wet,												
Brewers' grains, dry,												
Buckwheat middlings,												
Buckwheat (ground),												
Buffalo gluten feed,												
Cerealine feed,												
Corn meal,			2									
Corn and cob meal,	4	4		4			4¾	4¾	8	4	6½	5
Corn stover,	10	10	10	10	2½	8	10	10	10	8	9	8
Corn ensilage,					45	45						
Clover hay,												6
Cotton seed meal,		2		2		3		2		1		
Chicago gluten meal,												
Germ meal,												
Gluten meal,												
Hominy chop,												
Linseed meal,		2		2		2		3		2	2	4
Mixed hay,	10	10	10	10			4½	10	12	8		
Malt sprouts,												
Meadow hay,												
Mangolds,												
Millet hay,												
Oats (grain ground),			2								4	2
Oats, straw,									3	3		
Potatoes,												
Rutabagas,												
Rye straw,												
Rye, green,												
Skimmed milk,												
Timothy hay,												
Wheat bran,	8	4	8	4	3	3	2¼	2¼	2½	2½		
Wheat chaff,												
Wheat middlings,												
Wheat shorts,												
Wheat straw,												

Components of Pennsylvania Rations for Dairy Cows—*Continued.*

Ration No.	79		80		81		82		83		84	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barley meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brewers' grains, wet,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brewers' grains, dry,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buckwheat middlings,	.....	.....	.....	.....	.....	.....	5	5	.....	.....	.....	.....
Buckwheat (ground),	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buffalo gluten feed,	.....	.....	.....	.....	.....	.....	.....	.....	5	4	.....	.....
Cerealine feed,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Corn meal,	.....	.....	.....	.....	5	3	.....	.....	.....	.....	.....	.....
Corn and cob meal,	.....	.....	.....	.....	.....	.....	.....	.....	4	3	.....	.....
Corn stover,	9	14	9	14	10	6	10	10	12	6	.....	.....
Corn ensilage,	.....	.....	.....	.....	.....	.....	25	25	.....	25	50	45
Clover hay,	4	8	4	8	10	6	3	3	.....	.....	.....	6
Cotton seed meal,	.....	.....	.....	.....	.....	.....	.....	.....	3	3	.....	3
Chicago gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Germ meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8
Hominy chop,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Linseed meal,	.....	3	1	3	.....	3	.....	.....	.....	.....	.....	.....
Mixed hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Malt sprouts,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Meadow hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mangolds,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Millet hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oats (grain ground),	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oats, straw,	.....	.....	.....	.....	.....	.....	.....	.....	10	5	.....	.....
Potatoes,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rutabagas,	.....	.....	.....	.....	10	10	.....	.....	.....	.....	.....	.....
Rye straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rye, green,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Skimmed milk,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Timothy hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat bran,	2	3	2	3	5	2	7	7	.....	.....	5	3
Wheat chaff,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat middlings,	2	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat shorts,	.....	.....	2	3	.....	.....	.....	.....	.....	.....	.....	.....
Wheat straw,	.....	.....	.....	.....	10	6	.....	.....	.....	.....	.....	.....

COMPONENTS OF PENNSYLVANIA RATIONS FOR DAIRY COWS—*Continued.*

Ration No.	85		86		87		88		89		90	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.
Atlas gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barley meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brewers' grains, wet,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brewers' grains, dry,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buckwheat middlings,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buckwheat (ground),	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buffalo gluten feed,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cerealine feed,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Corn meal,	.....	.....	.....	.....	3	3	.....	.....	.....	.....	6	5
Corn and cob meal,	10	4	.....	.....	.....	.....	.....	2	.....	.....	.....	.....
Corn stover,	10	10	.....	.....	.....	.....	.....	.....	3	3	10	10
Corn ensilage,	.....	.....	30	30	.....	.....	.....	.....	.....	.....	.....	.....
Clover hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11	10
Cotton seed meal,	.....	.....	.....	1½	.....	1½	.....	.....	.....	.....	.....	1½
Chicago gluten meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Germ meal,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Gluten meal,	.....	.....	5	5	.....	.....	.....	3	6	6	.....	.....
Hominy chop,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Linseed meal,	.....	3	.....	.....	.....	1½	.....	.....	2	2	.....	2
Mixed hay,	2½	6	.....	.....	.....	.....	5	8	15	15	.....	.....
Malt sprouts,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Meadow hay,	.....	.....	8	8	26	20	.....	.....	.....	.....	.....	.....
Mangolds,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Millet hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oats (grain ground),	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....
Oats, straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Potatoes,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rutabagas,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rye straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rye, green,	.....	.....	.....	.....	.....	.....	60	60	.....	.....	.....	.....
Skimmed milk,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Timothy hay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat bran,	8	2	.....	.....	2	2	2	2	4	4	.....	.....
Wheat chaff,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat middlings,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat shorts,	7½	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wheat straw,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

COMPONENTS OF PENNSYLVANIA RATIONS FOR DAIRY COWS—*Continued.*

Ration No.	91		92		93		94		95		96	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal,												
Barley meal,											7	6
Brewers' grains, wet,												
Brewers' grains, dry,												
Buckwheat middlings,												
Buckwheat (ground),												
Buffalo gluten feed,												
Cerealine feed,												
Corn meal,	6	4			5½	5½						
Corn and cob meal,							5	4	2½	5		
Corn stover,	10	10			6	6	5	5	4	4		
Corn ensilage,												
Clover hay,					8	8	15	15			16	16
Cotton seed meal,		2										
Chicago gluten meal,												
Germ meal,												
Gluten meal,			3	5						1½		
Hominy chop,												
Linseed meal,		3			2	4		3		1½	3	3
Mixed hay,	9	9	22	16					16	16		
Malt sprouts,												
Meadow hay,												
Mangolds,												
Millet hay,												
Oats (grain ground),	2				1¾				1½			
Oats, straw,												
Potatoes,			20	20								
Rutabagas,												
Rye straw,												
Rye, green,												
Skimmed milk,												
Timothy hay,												
Wheat bran,					3	3			2	3	3	2
Wheat chaff,												
Wheat middlings,							5	3				
Wheat shorts,												
Wheat straw,												

COMPONENTS OF PENNSYLVANIA RATIONS FOR DAIRY COWS—*Continued.*

Ration No	97		98		99		100		101		102	
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Atlas gluten meal,												
Barley meal,									5	3		
Brewers grains, wet,												
Brewers grains, dry,												
Buckwheat middlings,						4						
Buckwheat ground,					4							
Buffalo gluten meal,												
Cerealine feed,												
Corn meal,	7	7	4	3			8	5				
Corn and cob meal,									5	3	7¼	4
Corn stover,											5	5
Corn ensilage,												
Clover hay,												
Cotton seed meal,				1				1½		1½		
Chicago gluten meal,												
Germ meal,												
Gluten meal,												
Hominy chop,												
Linseed meal,	3	3		2				1½		2½		3
Mixed hay,	12	12	18	18	18	14	25	18			15	15
Malt sprouts,												
Meadow hay,												
Mangolds,												
Millet hay,												
Oats (grain ground),			4	3	4	4	4	2				
Oats straw,												
Potatoes,			18	20	20	20						
Rutabagas,												
Rye straw,												
Rye, green,												
Skimmed milk,												
Timothy hay,									15	15		
Wheat bran,	2	2									2	2
Wheat chaff,												
Wheat middlings,												
Wheat shorts,												
Wheat straw,												

Components of Pennsylvania Rations for Diary Cows—*Continued.*

Ration No.	103		104		105			
FEEDING STUFFS.	Original ration.	Improved ration.	Original ration.	Improved ration.	Original ration.	Improved ration.	Number of times used in original rations.	Number of times recommended in improved rations.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs		
Atlas gluten meal,	......	......	......	......	......	......	2	2
Barley meal,	......	......	......	......	......	......	2	2
Brewers' grains, wet,	......	......	......	......	......	......	1	1
Brewers' grains, dry,	......	......	......	......	......	......	0	0
Buckwheat middlings,	......	......	......	......	......	......	9	12
Buckwheat ground,	......	......	......	......	......	......	1	0
Buffalo gluten meal,	......	......	......	......	......	......	1	1
Cerealine feed,	......	......	......	......	......	......	1	1
Corn meal,	......	......	......	......	......	......	34	36
Corn and cob meal,	......	......	2½	3	7	4	38	39
Corn stover,	5	5	......	......	6	6	62	62
Corn ensilage,	......	......	......	......	......	......	30	35
Clover hay,	......	......	......	8	......	......	25	35
Cotton seed meal,	......	......	......	3	......	1½	15	43
Chicago gluten meal,	......	......	......	......	......	......	0	0
Germ meal,	......	......	......	......	......	......	1	0
Gluten meal,	......	......	......	......	......	......	14	19
Hominy chop,	......	......	......	......	......	......	1	1
Linseed meal,	......	2	......	......	......	1½	27	64
Mixed hay,	16	16	......	......	10	10	51	51
Malt sprouts,	......	......	......	......	......	......	0	0
Meadow hay,	......	......	......	......	......	......	4	4
Mangolds,	......	......	15	15	......	......	1	1
Millet hay,	......	......	......	......	......	......	1	1
Oats (grain ground),	......	......	2½	3	......	......	26	16
Oats, straw,	......	......	......	......	......	......	5	6
Potatoes,	......	......	......	......	......	......	5	5
Rutabagas,	......	......	......	......	......	......	3	3
Rye straw,	......	......	......	......	......	......	1	1
Rye, green,	......	......	......	......	......	......	1	1
Skimmed milk,	......	......	......	......	......	......	1	1
Timothy hay,	......	......	18	8	......	......	7	6
Wheat bran,	4	3	......	......	4	4	74	75
Wheat chaff,	2	2	......	......	......	......	3	3
Wheat middlings,	4½	3½	......	......	......	......	7	10
Wheat shorts,	......	......	......	......	......	......	2	2
Wheat straw,	......	......	......	......	......	......	1	1

VARIATIONS OF DIFFERENT RATIONS.

There is a very wide variation in the different rations, which indicates that the matter of feeding dairy cattle has not received the thought and study to which it is entitled. About 25 per cent. of the rations are, however, compounded in a very practical and scientific manner. Undoubtedly, those who have studied the subject the most carefully are making the most money, and find that in this, as well as any other trade or profession, eternal vigilance and hard work is the price of success.

Summary of Rations.

	Dry matter.	Digestible.				Cost of food.	Nutritive ratio.
		Protein.	Carbhydrates.	Fat.	Total.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	
Maximum,	46.45	5.44	23.94	1.70	32.33	30.1	1:12.8
Minimum,	12.02	.81	6.24	.25	8.14	7.1	1:3.6
Average of the 105 rations,	24.42	2.06	12.81	.73	16.51	17.0	1:7.5

It will be noted that the largest amount of food in the rations is about four times that of the smallest. We must admit that there is a large difference between the digestive powers of different cows, but cannot see how that two cows each weighing 1,000 pounds would be so widely different in their powers to consume and assimilate food.

SCALES AND BABCOCK TEST.

The scales and Babcock test are not, strictly speaking, a matter of feeding, but it is so closely allied to it that a few words upon the subject may not be amiss.

Until a few years ago, if a person wished to find out what an individual cow was doing, he had to keep the milk separate for from a day to a week and churn the cream obtained therefrom in a small churn. For a person who kept a large number of cows, this was a very expensive method. This has all been done away with, and a person has now at his command a method by which each cow in his herd can be tested accurately and cheaply.

The average cow of this State does not pay for the feed she eats, yet there could scarcely be found a herd of cows in which there were not some that were yielding a handsome profit to their owners. What remains to be done, then, is to discard the poor cows, and keep the good ones. To do this, each cow's milk should be carefully weighed, and tested by means of the Babcock test for butter fat. To have it exact the milk would have to be weighed at every milking. This would, however, take too much time for the average farmer and would not be carried out in most cases. A method which would be practical would be to weigh the milk for three or four days at the end of each month, and at the same time take a composite sample of the milk. The milk can be kept sweet by the use of corrosive sublimate or bichromate of potash for the three or four days, so that there would only need to be one test made. Taking the average yield of milk and butter fat per day for all the months, the cow was in milk on the basis of the yield for the three or four days in which the test was made, would be accurate enough for all practical purposes. The dairyman could then tell what cows were not paying for their feed, and by discarding them he could make his business pay a great deal better than he could by selling his best cows, as too many dairymen do to-day. Six good cows are worth twice as much as twelve poor ones. A person is apt to sell the cow that will bring him the most money, but, as a rule, there is not enough of difference between the price of a good and a poor cow.

The cost of keeping cows is practically the same, whether they give five or ten pounds of butter per week. Any one wishing instructions on how to manipulate the Babcock test can obtain them free of charge, by addressing The Agricultural Experiment Station, State College, Centre Co., Pa., for Bulletin No. 33. Good Babcock testers can be secured from any of the reliable dairy supply houses for from $3 to $8.

GLOSSARY.

Albuminoids.—(*See protein and principles of scientific feeding.*)

Alfalfa.—" During a single season alfalfa furnishes a large amount of nutritious green forage relished by all kinds of stock. It should be partially wilted or mixed with hay or straw. In the dry regions of the West it is much used for pasturage, especially in the fall, but there is more or less danger that it will cause the cattle to bloat or that the plants will be killed by close pasturing. Cattle, sheep and horses relish alfalfa hay and seem to thrive on it.

"Chemical analyses and digestion experiments show that alfalfa compares very favorably with red clover both as green fodder and as hay. It may be used either for fattening or for milk. To secure a well-balanced and economical ration, alfalfa, which contains a large proportion of protein, should be fed with corn, wheat, oat straw, root crops, etc., which contain relatively large amounts of the other food ingredients (carbohydrates and fat). In many instances farmers might profitably raise alfalfa as a substitute for the wheat bran, cotton seed meal, and other materials which contain large amounts of protein and which they are now buying in order to utilize the excess of carbohydrates produced in corn and other crops (N. J. R. 1888, p. 110)."

ATLAS GLUTEN MEAL.—(*See Gluten Meal.*)

ASH.—"Ash is what is left when the combustible part of a feeding stuff is burnt away. It consists chiefly of lime, magnesia, potash, soda, iron, chlorine, and carbonic, sulphuric and phosphoric acids, and is used largely in making bone. From the ash constituents of the food the animal body selects those which it needs and the rest are voided in the manure."

ASSIMILATION OF FOOD.—By assimilation of food is meant the part of the food that is digested by the animal and taken into the blood vessels to build up the waste tissues, to form milk, etc.

BALANCED RATION.—When a ration is balanced, the proportion between the grain and coarse fodder is about 1 to 2, the amount of digestible matter it contains compares closely with the German standard, the nutritive ratio about 1 to 5 or 1 to 6, and the foods it contains will produce the proper physiological effect upon the animal.

BREWERS' GRAINS.—"In the manufacture of beer, it is the effort of the brewer to convert the starch contained in the barley or other grain used, first into sugar and then into alcohol, without removing any other material from the grain. As a consequence, the resulting grains contain larger percentages of every other ingredient, notably protein. As regards their percentage of the latter ingredient the dried grains are quite similar to peas, but on the other hand, they contain three times as much woody fibre as peas and correspondingly less starchy matter. In appearance and physical properties they resemble oats or barley but are richer in protein. Owing to their richness in protein, they can be judiciously used to balance up a ration deficient in this ingredient and are, therefore, of special value for milk production and probably for growth. At $14 per ton they would constitute a relatively cheap grain feed."

BUCKWHEAT MIDDLINGS.—The flour of the buckwheat would, as a rule, better be sold and only the middlings retained for feeding. At present, buckwheat middlings is one of the cheapest nitrogenous by-products on the market, and can often be used to advantage to balance up a ration. It is palatable, but has a slight costive tendency, which can be overcome by feeding in connection with it some linseed meal, bran, ensilage, etc. It was fed to the Experiment Station herd at State College for three months with no ill effects on the health of the cows, or of the calves born while it was being fed. Not only the amount of milk and butter produced, but also its quality was very satisfactory. For the amount fed in connection with other foods, see ration No. 66.

Buffalo Gluten Meal.—(*See Gluten Meal.*)

Calorie.—(*See Fuel-Value.*) The fuel-value of feeding stuffs is measured in calories. One small calorie is the amount of heat required to raise the temperature of one gram (15.45 grains) of water from 0 degrees to 1 degree of the centigrade scale. One large calorie is the amount of heat required to raise the temperature of one kilogram (1,000 grams or 2.205 pounds) of water from 0 degrees to 1 degree centigrade. One large calorie, therefore, equals 1,000 small calories.

The abbreviation cal. (with a small "c") is commonly used for the small calorie, and Cal (with a capital "C") for the large calorie.

Carbohydrates.—Carbohydrates are usually divided into two groups—nitrogen-free extract, including starch, sugar, gums and the like, and cellulose or fiber, the essential constituent of the walls of vegetable cells. Cotton fiber and wood pulp are nearly pure cellulose. The carbohydrates form the largest part of the dry matter of all vegetable foods. They are not permanently stored up as such in the animal body, but are either stored up as fat or burned in the system to produce heat and energy."

Carbhydrates.—Only a different way of spelling carbohydrates.

Carrots.—"Carrots were used in feeding experiments with milch cows at the Massachusetts State Station each season from 1887 to 1889 (R. 1887, p. 11, R. 1888, p. 11, R. 1889, p. 37). The special object was to compare the feeding value of carrots (and sugar beets) with that of corn silage. In R. 1888, p. 17, it is stated that 'the nutritive feeding value of carrots, taking into consideration pound for pound the dry matter they contain, exceeds that of corn silage as an ingredient of the daily diet, in place of a part (one-half) of the hay fed.' "

Cerfaline Feed. Cerealine feed consists largely of the germ and hull of the corn grain, it being the refuse of the corn from the cerealine manufactories. It is not as rich in protein as gluten meal, the nutritive ratio being 1:7.8. (See table showing composition of feeding stuffs). The price will determine whether or not it can be used to advantage, but think that at $12.00 per ton it would be a very cheap feed.

Chicago Gluten Meal.—(*See Gluten Meal.*)

Clover Hay.—Every dairyman knows of the high feeding value of clover hay, and it is one of the best coarse fodders that can be grown upon the farm. The nutritive ratio is 1:6, which makes it, in itself almost a perfect dairy food. When cured properly and at the right time, a cow cannot be injured by giving her all she will eat.

Clover Silage.—Clover, if cut at the proper time, makes excellent ensilage. We have filled our silo the past three years with red clover with very satisfactory results. The objections raised against hay made from crimson clover on account of the awns could be overcome if it were put into a silo. In the latter part of May, at the time that it matures, it is often wet, so that it is difficult to dry the clover. By having a silo, the clover could be put in green and not need any sunshine.

Coarse Fodder. By coarse fodder is meant hay, made from the different grasses, and clover, corn stover and wheat, oats and rye straw.

Corn-and-cob Meal.—"The corn and cob are often ground together without shelling, and where the cob is not too large and woody, the corn-and-cob meal has given good results in feeding. The ground cob is believed to be of value (1) on account of the food and the ash constituents which it contains, and (2) on account of the beneficial mechanical influence which it has on the digestion of the corn meal. The feeding of corn-and-cob meal depends somewhat on the relative proportion of cob and kernels in the ear, which differ in different varieties. Goessmann found that the proportion of cob in the ear varied from 14 to 18 per cent. by weight.'"

Corn Fodder.—In this State the term corn fodder usually applies to the corn stalks after the ears have been taken off. In the Western states and in all scientific publications, corn fodder means the corn stalk and ear taken together. For notes on feeding see corn ensilage.

Corn Meal.—"For amount of comparisons of corn meal with cotton seed meal, gluten meal and linseed meal for milk and butter production, see *cotton seed meal, gluten meal* and *linseed meal.*"

Corn Silage.

Silage for Milk and Butter Production.—This subject embraces comparisons of corn silage (1) with corn fodder, (2) with hay, and (3) with roots.

Silage vs. Dry Corn Fodder—"The Wisconsin Station has made experiment for six years to compare the value of corn silage and dry corn fodder for milk and butter production (R. 1886, p. 25, R. 1888, p. 5, R. 1889, pp. 69, 130, R. 1890, p. 80, R. 1891, p. 49). In these experiments the corn fodder has not been allowed to stand long in the field after cutting but has been kept under cover. Both the silage and corn fodder have constituted a larger proportion of the ration than would ordinarily be the case in practice to obtain the maximum difference in the effect of these fodders. As a rule, the cows relished the silage and thrived upon it. The results of the comparison of the two foods have not always been uniform from year to year, but they have never been at all pronounced in favor of either food. The silage has sometimes given a slightly larger quantity of more watery milk than the corn fodder; and in other experiments this result has been reversed.

In other experiments a larger yield of both milk and fat on silage has been accounted for by the fact of the cows having eaten more silage than corn fodder. But when the results of the six years are summarized the conclusion is that "properly cured corn fodder and corn silage of similar variety and maturity are of equal value for milk and butter production." In several experiments the silage was found to possess a somewhat higher rate of digestibility than the corn fodder.

Regarding the relative amounts of milk and butter produced from silage and corn fodder grown on equal areas of land the Wisconsin Station (R. 1891, p. 49) reports an experiment made to test this point in which 20 cows were fed the product from nearly 6 acres.

"Summarizing our work in this line, we have the following conclusions:

"(1) A daily ration of 4 pounds of hay and 7 pounds of grain feed, with corn silage or field-cured fodder corn ad libitum. fed to 20 cows during sixteen weeks, produced a total quantity of 19,813.4 pounds of milk during the silage periods and 19,801.2 pounds of milk during the fodder corn periods.

"(2) When we consider the areas of land from which the silage and fodder corn fed were obtained, we find that the silage would have produced 243 pounds more milk per acre than the dry fodder, or the equivalent of 12 pounds of butter. This is a gain of a little more than 3 per cent. in favor of the silage."

The New Jersey Station (B. 19) found that (1) the loss of food ingredients was less in the stack than in the silo; (2) cut and crushed corn fodder was eaten by cows quite as readily and with as little waste as silage; (3) in three out of four cases there was no increase of milk on silage; and (4) with one herd there was an increased yield of total solids in the milk during the silage period, and with the other no increase.

In a trial at the Michigan Station (B. 47, R. 1889, p. 205), cows gave somewhat more milk on dry corn fodder than on silage, but the silage lasted longer than the corn fodder from a similar area, although nearly a quarter of the silage spoiled. The tendency seemed to be to gain in live weight on silage feeding rather than to produce milk.

A trial at the Missouri Station (B. 8) was favorable to dry corn fodder. "Dry fodder corn for cows proved more effective, especially dried sugar corn, than silage. Cows fed on dry fodder corn gave the richest milk, the best butter, which seemed to keep better, and maintained their live weight best."

In a comparison of a number of different coarse foods, the Vermont Station (R. 1889, p. 51) found corn fodder and corn silage from the same source to give practically like results per pound of dry matter eaten, although average silage proved superior to average corn fodder, and both were superior to corn stover. "Good corn silage caused gain in all respects over good hay," and "hay and corn stover had much the same effect on milk production."

In a later series of experiments at the same station (Vt. R. 1891, p. 75) the yield of milk was larger on silage than on corn fodder, but the milk was of poorer quality on silage, containing 12.91 per cent. solids and 4.05 per cent. fat on an average, while it averaged 13.25 per cent. solids and 4.28 per cent. fat on corn fodder. The total yield of milk constituents (fat, etc.), was slightly higher on silage. Considering the yield of milk and butter fat on silage and corn fodder from like areas of land, the result was favorable to silage, showing that on it 8 per cent. more milk, 5 per cent. more solids, and 3 per cent. more fat were produced than on corn fodder. A pound of dry matter in silage produced more milk and slightly more solids and fat in six out of nine cases than a pound of dry matter in corn fodder. The loss of dry matter was 20 per cent. in ensiling and 19 per cent. in field curing in shocks, but the loss of albuminoids was largest in field curing. The result of this comparison of corn fodder and silage agreed practically with that at the Wisconsin Station.

At the Pennsylvania Station (R. 1890, p. 79), while more milk was produced on silage than on corn fodder, it was of poorer quality, so that the total yield of butter fat was slightly larger on the corn fodder. Pound for pound of dry matter, more milk and more solids were produced on the silage ration. "The greater efficiency of the silage ration was due to the greater digestibility of the silage."

Silage vs. hay.—Experiments were carried on at the Massachusetts State Station for five years (1885-'89) to compare corn fodder, corn stover and corn silage with good English hay for the production of milk. (Mass. State R. 1885, p. 10, R. 1886, p. 11, R. 1887, p. 11, R. 1888, p 11, R. 1889, p. 12). The effect of these feeding stuffs was studied on the yield and composition of the milk, the total and net cost of the milk per quart, and the physical condition of the animals. These coarse foods were invariably fed in connection with a grain ration. Silage was usually fed with some hay; corn fodder and stover were usually fed alone with the grain ration. The valuation used in calculating the cost of food per quart of milk was the same in all experiments, i. e., hay, $15.00; corn fodder, $5.00; corn stover, $5.00; corn silage, $2.75 per ton; and in calculating the net cost 80 per cent. of the value of the fertilizing ingredients of the food was deducted from the first cost, it being assumed that 80 per cent. of the fertilizing ingredients can be recovered in the manure. The corn fodder, stover and silage were usually fed cut or shredded. The corn fodder was cured in the field and was invariably cut at the same stage as the silage—usually when the kernels were beginning to glaze.

First, concerning the effect of these fodders on the cost of milk production, the result of the experiments showed that in every instance the cost was highest when hay was fed alone. Whenever a part of the hay was replaced by either corn fodder, stover or silage the cost was materially reduced, often as much as one-half cent per quart of milk. When corn fodder, stover or silage were fed alone (with grain) the cost was likewise reduced, and between these three fodders, at the prices charged, little uniform advantage could be traced. In general, their ability to reduce the cost depended upon the extent to which they replaced the hay.

As to the comparative value of these fodders for food, Prof. Goessmann says that, pound for pound of dry matter, they have proved "fully equal, if not superior, to average English hay." At the close of the fifth year of experiment he says: "To produce a quart of milk, using the same quantity and quality of grain food, required in every instance a larger quantity of perfectly dried hay than of either corn fodder, corn stover or corn silage in a corresponding state of dryness. Corn silage was most advantageously fed in place of one-fourth to one-half of the full hay ration. From 35 to 40 pounds of silage per day, with all the hay called for to satisfy the animal (in addition to the grain ration), seems a good proportion." The fodders compared well as far as quantity and quality of milk and of cream was concerned.

The Maine Station (R. 1889, p. 69) found that when one-third of the hay (mostly timothy) was replaced by silage a somewhat higher milk yield was maintained for sixty-three days than on hay exclusively (preceding period) with practically no change in the composition of the milk. This was not due to a larger amount of digestible food being eaten while on silage than on hay.

The Minnesota Station (R. 1888, p. 112) compared timothy hay and silage made from large southern varieties of corn, replacing the hay entirely by silage. The silage was sour and the cows "did not eat enough of the ration to either maintain the flow of milk or to keep from falling off in weight. * * * The hay and grain ration produced an unusual and undesirable increase in live weight."

In a trial at the Vermont Station (R. 1890, p. 86) "silage gave less milk than hay, the quality being the same;" and corn fodder gave less milk of slightly poorer quality than hay.

At the Wisconsin Station (R. 1884, p. 11) corn stover fed uncut was compared with mixed hay and with clover hay. Fed in this way there was a considerable loss of stover, and it was found to be equivalent to about one-third of its weight of mixed hay or somewhat less than one-third of its weight of clover hay.

According to the New Hampshire Station (B. 13) "hay apparently produced a harder butter than silage," but the relative yield on the two foods is not stated.

Silage vs. Roots.—Experiments covering several years have been made at the Massachusetts State Station (R. 1886, p. 11, R. 1887, p. 11, R. 1889, p. 12). In these the cost of food per quart of milk was higher with sugar beets at $5.00 or carrots at $7.00 per ton than with silage at $2.75 or corn fodder at $5.00 per ton. In feeding value, however, Dr. Goessmann states that the roots were fully equal if not superior to silage, pound for pound, of dry matter. Both root crops almost without exception increased the temporary yield of milk, exceeding, as a rule, the corn silage in that direction. It is suggested that from 25 to 27 pounds of roots per day be fed in place of part of the hay.

The Ohio Station (B. Vol. II, 3, B. Vol. III, 5) reports two experiments made to compare silage and sugar beets for milk production. In both experiments the cost of food per quart of milk was a fraction of a cent less on silage at $2.30 per ton than on beets at $2.00. These prices are the estimated cost of production of the crops. In 1890 the yield of milk was considerably and in 1889 slightly higher on beets than on silage; but in 1889 the silage showed a greater tendency than the beets to increase the live weight, while in 1890 the cows gained a pound a day in weight on beets and lost a pound on silage. No data are give as to the composition of the milk.

A comparison at the New York State Station (R. 1890, p. 364) of mangel-wurzels and silage resulted favorably, financially and otherwise, to the silage. The roots and silage were each reckoned at $3.00 per ton.

From a comparison of roots and silage at the Pennsylvania Station (R. 1890, p. 79) the inference was that roots were slightly inferior to silage, more digestible matter being required per pound of milk solids or fat than on silage.

CORN STOVER.—"The corn plant after the ears are taken off. In feeding trials, the Vermont Station found (R. 1889, p. 51) that corn stover and hay 'have about the same feeding value for cows,' and 'the lower half (butts) of corn stover have as great feeding value per pound of dry matter as the upper half (tips).' The corn furnishing the stover was presumably a Northern variety. See also silage."

COTTON SEED MEAL.

"COTTON SEED AND COTTON-SEED MEAL FOR MILK AND BUTTER PRODUCTION.—-The Texas Station (B. 11) found that as compared with corn-and-cob meal, feeding cotton seed or cotton-seed meal improved the creaming of the milk in deep setting, and several stations have found that it tends to give a firmer, harder butter (see *Butter making, effect of food on churnability and on quality of butter.* In experiments in two years at the Maine Station (R. 1885-'86, p. 65, R. 1887, p. 84) the substitution of cotton-seed meal for an equal quantity of corn meal in each case increased the production of both milk and butter to a profitable extent.

"At the Mississippi Station (B. 11, B. 13, B. 15) cotton seed at $9 was found more economical than cotton seed meal at $20, and the latter was cheaper than corn meal at $25 per ton. The same station (B. 21) concludes from three years' work that 'the milk and butter from cows fed on steamed cotton seed cost less than that from cows fed on raw cotton seed, and but little more than one-half as much as that from cows fed on cotton seed meal. The butter from steamed cotton seed is superior in quality to that from either raw seed or cotton seed meal.' "

"Cotton seed meal was compared with equal quantities of gluten meal and linseed meal, fed singly, at the Massachusetts Station (B. 41). When these were fed with hay the yield of milk was highest on cotton seed meal in the case of five out of six cows, with no material change in composition of milk, but when fed with corn stover or hay and silage the gluten meal compared well with the cotton seed meal. Making allowance for the value of the fertilizing ingredients, which is highest in case of the cotton seed meal, the net cost of the cotton seed meal ration was the lowest of these grains.

Feeding six pounds of cotton seed meal per head and per day did not seem to affect the health of the animals at the Pennsylvania Station (B. 17). This station compared cotton seed meal with wheat bran, pound for pound, with the result that the milk yield increased about one-fifth and the butter quite materially on cotton seed meal; the melting point of the butter was higher, but the general quality of the butter was rated considerably lower than that produced on bran."

CREAM GLUTEN MEAL.—(*See gluten meal.*)

CRUDE FIBRE.—(*See carbohydrates.*)

DIGESTIBILITY OF FOODS.—" A portion of the food which is eaten is dissolved and otherwise altered by the juices of the mouth, stomach and intestines, taken up from the alimentary canal, and in the form of chyle passes into the blood and finally serves to nourish and sustain the body. This portion is said to be digested and assimilated and from it alone the animal is nourished. The other portion, which is not digested, passes on through the body and is excreted in manure. As the rates of digestibility are not constant for different foods and as only the digestible portion is of any nutritive use to the animal, it is essential to know in the case of each feeding stuff what part of its protein, fat, and carbohydrates, the total quantity of which is shown by analysis, is actually digested by the animal. This is determined by actual feeding trials with animals, and to secure approximately accurate figures the trials are repeated with a large number of animals and under various conditions. Many such practical trials have been made chiefly at German experiment stations. The larger number of these have been with cattle and sheep, though some have also been made with horses and swine."

DIGESTIBLE MATTER.—(*See Digestibility of Foods.*)

DRY MATTER.—The dry matter is the water free substance. The per cent. of water is subtracted from 100, the remainder equals the dry matter.

ENSILAGE.—See corn silage.

FAT.—"Fat, or the materials dissolved from a feeding stuff by absolute ether, includes, besides real fats, wax, the green coloring matter of plans, etc. For this reason the ether extract is usually designated crude fat. The fat of food is either stored up in the body as fat or burned to furnish heat and energy.

FOOD—EFFECT OF, ON QUALITY OF BUTTER.

EFFECT OF FOOD ON QUALITY OF BUTTER.—The New York State Station (R. 1889, p. 117) in summarizing the results of experiments for two years, reports that "the character of the food did largely influence both the yield and the quality of butter." The butter made on linseed meal was too soft. Oats gave the best colored and the hardest butter, but it was rather crumbly. With reference to the effect of cotton seed and cotton seed meal on the character of butter, several experiments have been made in this country which are of interest, showing that the melting point of butter was higher and the percentage of volatile fatty acids lower with cotton seed or cotton seed meal than without it, i. e., that a firmer, harder butter was produced when these foods were fed. This observation was first made by the Texas Station (B. 11) and was confirmed by experiments by the United States Department of Agriculture in co-operation with the Maryland Station (Proc. Socy. Prom. Agr'l Science, 1889), and at the Alabama College Station (B. 25, n. ser.). In the latter case the melting point of the butter increased 12 degrees to 14 degrees Fahrenheit when cotton seed or cotton seed meal was fed. In trials at the Pennsylvania Station (B. 17) the melting point only was determined, but this was from 3 degrees to 9 degrees Fahrenheit, higher on the cotton seed meal ration than on the bran ration. The melting point on the former ration ranged from 96 degrees to 102 degrees and averaged 99 degrees; on the bran ration it ranged from 91 degrees to 97 degrees and averaged 93 degrees.

In the trials at the Texas and Pennsylvania Stations samples of the butters were submitted to a board of judges to be rated. In all cases the butter produced on cotton seed or cotton seed meal was rated considerably lower than that made on rations without these foods. In Texas it was stated that these foods affected the texture of the butter in a similar way to overworking, and gave a colorless butter.

At the New Hampshire Station comparisons of butters made on gluten meal, corn meal, cotton seed meal, or skim milk, with a basal ration, showed the butter on the gluten meal ration to be softer than any of the others. It was also found that silage produced a somewhat softer butter than hay. "The iodine absorption of butter from gluten meal rations was greater than that of butter from cotton seed or corn meal rations." (N. Y. State R. 1888, p. 292.)

There seems, then, little doubt that certain qualities of butter are influenced by the character of the food, and that cotton seed and cotton seed meal tend to the production of a relatively hard butter.

FUEL-VALUE.—(See Calorie). The fuel-value of a feeding stuff is the amount of heat (measured in calories) which it is capable of giving off in the body of the animal when fully utilized.

It measures the value of the feeding stuffs as a means of maintaining the "animal heat," and also is probably the best measure which we now possess of its value for the production of fat and of work.

GLUTEN MEAL.—"This material is obtained as a by-product in the manufacture of starch and glucose sugar from corn. It consists largely of the germ (chit), the richest part of the corn, with more or less hulls and starch. The supply of this substance has acquired considerable proportions in consequence of the development of the glucose industry in this country. As shown by the analyses .... it is richly nitrogenous material, and it has found quite extensive use for feeding animals. The variations in composition are mainly due to modifications in the process of manufacture.

"GLUTEN MEAL FOR MILK AND BUTTER PRODUCTION.—In 1883 the New York State Station (B. 34, B. 35) reported trials with gluten meal which indicated that, as compared with bran or corn meal, it was most profitable for milk production. 'It surfeits the cattle easily and becomes unpalatable to them. Our impression is that unless fed with care it may prove an injurious food.'

"Later the Massachusetts State Station (R. 1884, p. 42), fed it with an equal weight of wheat bran 'to compensate for its deficiency in phosphates of lime and magnesia and to render it more palatable. The desired amount of both substances was mixed and moistened and fed during milking.' The results following the feeding were satisfactory and indicated it to be a valuable feeding stuff. It was compared with cotton seed meal and old process linseed meal (B. 41) with the result stated under cotton seed and cotton seed meal.

"The New York State Station (B. 9, n. ser.) reports a case in which two cows died after being fed eight quarts of gluten meal daily in connection with four quarts of middlings and corn-and-cob meal. This furnishes an excessive amount of albuminoids 'which experience has shown is likely to produce sickness, and, if followed up, death. Our verdict must be: 'The fault is in the user, not in the material.' " In a feeding trial at New York State Station (R. 1889, p. 198) gluten meal (six pounds per day) gave a larger yield of milk than either corn meal, ground oats or linseed meal, although the latter was poorly eaten; but the indications were that the gluten meal did not increase the solids and fat in proportion to the yield of milk.

"The New Hampshire Station (B. 13) observed that gluten meal almost invariably increased the milk yield over corn meal, but made no mention of the quality.

"The Iowa Station (B. 14) found that as compared with corn-and-cob meal, gluten meal improved the quality of the milk and decidedly increased the total amount of solids and fat contained in the milk."

GERM MEAL.—This is the germ and bran of the corn (maize) grain. It resembles cerealine feed in composition and is probably the same material under a different name.

HOMINY CHOP.—This is also made from corn and does not differ materially in composition from germ meal and cerealine feed.

LINSEED MEAL.—"The linseed meal used in feeding is the ground press cake remaining after the extraction of linseed oil from flaxseed. The old process of removing the oil from the seed was not as thorough as the new process, so that there is considerable difference between the composition of old process and new process linseed meal. The new process meal contains less than half as much fat (oil) and rather more protein than the old process meal.

"LINSEED MEAL FOR MILK AND BUTTER PRODUCTION.—Old and new process linseed meal were compared at the Massachusetts State Station (B. 38, R. 1890, p. 15) as to the quantity and quality of milk produced and the cost. The old process meal was bought at $27 and the new process at $26 per ton. The value of the fertilizing ingredients was somewhat higher in the new process meal, making the net cost of food a little lower than for old process meal. In general the yield of milk and the percentage of fat in the milk was higher on the old process meal.

"For the result of a comparison of old process linseed meal with cotton seed meal and gluten meal by the same station (B. 41) see cotton seed meal for milk and butter production.

"Two comparisons of new process linseed meal with corn meal reported by the Wisconsin Station (R. 1885, p. 97) gave opposite results, one showing little, if any advantage, and the other a decided advantage for linseed meal over corn meal. A comparison of linseed meal and wheat bran at the same station (R. 1886, p. 130) indicated that pound for pound the linseed meal gave slightly the larger milk production, but assuming bran to cost $12 and linseed meal $25 per ton, bran was much the cheaper food.

"The Iowa Station (B. 14) observed that 'the substitution of bran and oil (linseed) meal for half the amount of corn meal resulted in a marked increase in both quantity and quality of milk, the increase in quality being still more than the increase in quantity.'

"In comparison of linseed meal, corn meal and bran, the New York State Station (R. 1887, p. 15) noticed that an increase in the amount of albuminoids fed was favorable to increase in both milk yield and live weight; that the albuminoids in linseed meal seemed to be more especially favorable to increase in live weight, and those in the bran to increase in milk yield. In other words, this experiment indicated wheat bran to be the better of the two for milk production.

"The Iowa Station (B. 16) made an experiment to ascertain how much linseed meal might be fed without injury, and found that with mature cows eight pounds per day might be fed, provided the cows were accustomed to it gradually; and that no ill effects resulted from feeding large amounts of linseed meal to pregnant cows. (N. Y. State R. 1889, p. 198; Vt. R. 1890, p. 88.)"

Maintenance Ration.—By a maintenance ration we mean a ration that contains just enough food to keep the animal at the same live weight.

Mangels.—Mangels are very useful for winter dairying to aid the digestion of the animal when no other succulent food is available.

For dairymen who do not have a silo, one or two acres of mangels could be grown to very good advantage. Pound for pound of dry matter they are slightly superior to corn ensilage for milk and butter production, but as it costs four or five times as much per acre to grow them, the ensilage is the cheapest in the end.

Mangold Wurzels.—(*See Mangels.*)

Milk—Effect of Food.—"The question of the effect of food upon the yield and composition of milk is one which has called forth a variety of opinion and much experimental work. It is held by many that food is, after all, of only secondary importance, and that much more depends upon the qualities of the animal itself, the size of the milk glands and the capability of the latter for producing milk. At the same time a certain amount of food is of course necessary to keep up the secretion. The belief is prevalent among farmers that the character of the food or the proportion of food ingredients it contains directly or indirectly influences the milk secretion, and this belief is borne out by the results of some feeding experiments in this country and abroad. The effect of food on the milk secretion may make itself apparent in several ways. (1) The quantity may increase or decrease, resulting in a more or less watery milk; (2) the quantity of milk yielded may increase or decrease without any change in the composition of the milk; (3) the proportion of solids to water may change without any change in the quantity of milk yielded, also resulting in a richer or poorer milk; (4) the milk may become richer in respect to a single milk ingredient without a change in the other solids; and finally (5) the taste of milk may be affected. The first case involves a change in the water content alone. The second and third cases involve an increased or diminished production of solid ingredients by the milk glands. The fourth case involves increased production of a single milk ingredient without a corresponding increase of the others. The fifth case is generally supposed to result from the transmission of qualities from the food to the milk. It has recently been contended by a prominent authority abroad that the composition of milk is less subject to change as a result of feeding than is usually supposed to be the case and that grain or rich food added to a ration which already meets the food requirements of the animal does not influence the composition of the milk, although it may increase the yield of milk. The change in the relation of the different ingredients of the milk solids to each other, that is, a one-sided increase in the percentage of a single ingredient, has been noticed in only a few isolated cases and the ability to induce such a change appears to be characteristic of only a very limited number of foods.

"Numerous and various feeding experiments with cows have been made at our stations and the results of some of these have thrown light on the effect of food on milk secretion, although a large proportion have had other objects in view. Experiments extending over six years have been made at the Wisconsin Station to compare the effects of corn silage and field cured corn fodder on milk and butter production. The results of these have not been altogether consistent. In the earlier experiments (R. 1888, p. 28) the indications were that the silage tended to slightly increase the yield, giving a more watery milk. The later experiments (R. 1889, p. 130, R. 1890, p. 80), however, which form the majority, indicate that slightly more milk and of equally good quality was produced on silage.

"At the Massachusetts State Station, in a long series of comparisons of corn fodder, corn stover and corn silage, these materials were found to compare well, pound for pound, in their effect on yield and composition of milk.

"At the Michigan Station the yield of milk was found to be slightly larger on silage than on corn fodder.

"At the Maine Station, when corn silage and timothy hay (mostly timothy) were compared, the yield of milk was of equal or better quality on silage than on hay.

"At the Vermont Station (R. 1890, p. 86) the milk yield was larger on hay than on silage or corn fodder; the quality of the milk was maintained on silage, but fell off slightly on corn fodder.

"At the Massachusetts State Station (R. 1889, p. 12) in four years of comparison of corn fodder, corn stover, corn silage, sugar beets, carrots and hay, the effect of these different foods on the milk was not uniform with different cows, but seemed to be largely a matter of individuality. Both sugar beets and carrots when fed in place of part of the hay ration 'almost without exception raised the temporary yield of milk, as a rule exceeding the corn silage in that direction.'

"The summary in Vt. R. 1890, p. 73, of a large number of cases where cows were changed from succulent to dry food and vice versa, showed practically no change in the composition of the milk which could be attributed to the change of food. The same station found (R. 1890, p. 107) that the change from barn feed to pasturage was almost universally accompanied by a greater or less increase in both the yield and the richness of the milk. According to observations reported in 1891 (Vt. R. 1891, p. 69), the increase of pasturage averaged about one-fourth of a pound of butter per week per cow. These results, together with other observations at the station in the same line, lead to the statement that 'pasture feeding and watery food do not make watery milk.'

"At the Wisconsin Station (R. 1889, p. 146, R. 1890, p. 164), on the contrary, 'an increase in the amount of water drank was associated with an increase in the amount of milk produced;' and 'the water in the milk was greatest following the days when the most water was drank.'

"The New Jersey Station (B. 77) found in connection with its tests of dairy breeds that while the yield of milk generally increased during the summer months the quality fell off.

"With reference to the effect of grain feed, a comparison at the Wisconsin Station (R. 1885, p. 97) of old process linseed meal and corn meal gave indications that the linseed meal slightly improved the quality of the milk, but usually at the expense of quantity.

Pound for pound, linseed meal gave slightly larger yield of milk than bran, with no apparent change of quality due to food (Wis. R. 1886, p. 130). In a comparison of equal weights of ground oats and bran, the cows invariably increased in milk yield on oats, with practically no change in the fat content of the milk (Wis. R. 1890, p. 65).

"The Maine Station (R. 1885-'86, p. 65, R. 1886-'87, p. 84) found from trials in two years that 'the substitution of cotton seed meal for an equal quantity of corn meal unmistakably increased the production of milk and butter to a profitable extent.'

"At the Pennsylvania Station (B. 17) the substitution of cotton seed meal for bran was accompanied by an increase of about one-fifth in the yield of milk, with practically no change in percentage of fat in the milk.

"The New York State Station (R. 1891, p. 112) substituted cotton seed meal for corn meal and silage for part of the hay in the ration of seven cows well advanced in milk. The change in the ration was an increase in both albuminoids and fat in the food. Not only was the milk yield maintained for a month on this richer ration at a time when the cows might be expected to be drying up, but in the majority of cases the percentage of fat increased, so that in every case except two there was an absolute increase in the quantity of fat secreted in the richer ration.

"The Vermont Station (R. 1890, p. 75) studied the effect on milk of feeding a large amount of rich grain ration as compared with feeding a normal amount. The effect was not uniform with the different cows. One gave no return for the extra grain either in yield or in richness of milk, while two others responded to the extra grain by increased yield of milk, the quality of which was not diminished.

"The New York State Station (B. 106, B. 110. B. 114, R. 1884, p. 49) found that acid food, as spoiled or sour brewers' grains, wet starch feed, or dry starch feed to which acetic acid had been added, did not impart any unpleasant taste to milk or affect its keeping quality. The indications from a trial of feeding dry starch or glucose waste was that it tended to increase the yield of milk without affecting its composition (N. Y. State R. 1885, p. 10).

"The same station (B. 22, B. 34, B. 35) found gluten meal very favorable to milk yield.

"The New Hampshire Station (B. 14) noticed in comparison of gluten meal and corn meal that in almost every case with each of the eleven cows a change from gluten meal to corn meal, i. e., a change from a narrow to a wide nutritive ratio, resulted in a decided falling off in the product (milk) while the reverse change resulted in an equally decided increase.'

"Probably the most interesting experiment of all on this subject was made at the Iowa Station (B. 14) in a comparison of gluten meal with corn-and-cob meal. When a gluten meal containing large amounts of protein and fat, was fed there was an increase both in the percentage of total solids and fat and in the total amount of fat produced in the case of every cow. The proportion of fat to the other milk constituents was noticeably larger on gluten meal. This would seem to be a case of a one-sided increase of the fat, which, as mentioned above, has been noticed in only a few isolated cases. The effect of the gluten meal on the yield of milk was not uniform, but apparently there was little if any change in yield which could be attributed to the food.

"It will be seen that the results of carefully made experiments are often conflicting, which suggest that the element of individuality plays an important part in such experiments as these and makes it difficult to lay down fixed laws. The whole matter of the effect of food on milk and butter production is only imperfectly understood and needs more extended and consistent investigation.

"From the results cited above it seems safe to assume for the present that in general corn fodder, corn stover, corn silage, and probably the root crops do not unfavorably affect either the yield or composition of milk; that succulent foods do not necessarily produce watery milk; and that such rich nitrogenous foods as linseed meal, gluten meal, etc., are especially favorable to milk production. The extent to which these foods can be given will naturally depend upon circumstances, such as the character of the stock, and the market value of these feeding stuffs and of dairy products.

"(Iowa B. 13; Kans. R. 1888, p. 91; Mass. State B. 32, B. 34, B. 35, B. 38, B. 41. R. 1884, pp. 26, 59, R. 1885, p. 10, R. 1886, p. 11, R. 1887, pp. 11, 35, R. 1888, pp. 11, 38, R. 1889, pp.. .12, 48, R. 1890, p. 15, R. 1891, p. 59; Minn. R. 1888, p. 112; Miss. B. 13, B. 15; N. H. B. 13; N. J. B. 19; N. Y. State B. 1884, R. 1883, pp. 95, 156, R. 1887, p. 15 R. 1888, p. 297, R. 1890, pp. 8, 364; Vt. R. 1889, p. 51, R. 1890, pp. 51, 88, 107; Wis. R. 1884, p. 11, R. 1885, p. 9, R. 1886, pp. 25, 34, 147, R. 1888, pp. 5, 67, R. 1889, pp. 69, 130, R. 1890, p. 80.")

Mixed Hay —This term applies to hay that is composed of clover and timothy, 50 per cent. each.

Narrow Ration.—By a narrow ration is meant a ration in which the nutritive ratio is narrow. For instance, were the nutritive ratio of a ration 1:4 we would say it is a narrow ration.

Nitrogen.—"Nitrogen in the free or gaseous state constitutes about one-fifth of the atmosphere surrounding the earth; about 3 per cent. of the live weight of animals is nitrogen combined largely as albuminoids or protein compounds; and of all plants it is a prominent and important constituent.

"The nutritive value of all animal and vegetable foods depends largely upon the organic combinations of nitrogen which they contain. These nitrogenous or albuminoid constituents of foods are considered specially necessary to the formation of muscle, tendon and ligament in animals. Their composition and digestibility are therefore of great importance from the standpoint of animal production. The albuminoids are very variable in composition—Osborne has isolated and studied four distinct albuminoids from the corn kernel and five or more from the oat kernel (Conn. State R. 1890, p. 114, R. 1891, p. 136)—but all show a high percentage of nitrogen—16 per cent. may be considered a fair average. The proportion of nitrogen differs widely in different plants, in different parts of plants, and in the same plant at different stages of growth. The leguminous plants are especially rich in nitrogen; immature plants are, as a rule, richer than mature, and seeds than stems and leaves.

Nitrogen is of no less importance as an element of plant food. Notwithstanding its comparative abundance in nature, it is the most costly fertilizing ingredient which has to be supplied to soils. This is due to the comparative rapidity with which the organic nitrogen in the soil is reduced to the inert gaseous form by putrefactive ferments or is transformed by the process of nitrification into soluble compounds for which the soil has very slight retentive power (Ind. B. 33) and which are thus readily washed out by the drainage water.

NITROGEN, FREE EXTRACT.—(*See carbohydrates*)

NITROGENOUS BY-PRODUCTS AND FOOD—By this term is meant all by-products and foods that contain a large amount of nitrogen or protein, such as linseed meal, cotton seed meal, gluten meal, brewers' grain, clover hay, etc.

NON-ALBUMINOIDS.—This is a sub-division of protein. (*See protein and principles of scientific feeding.*)

NUTRITIVE RATIO.—(See how to calculate the nutritive ratio and total digestible matter, page 18.)

OATS.—(For effect on milk and butter production see *effect of food on Milk.*)

OIL MEAL, OIL CAKE MEAL.—Linseed meal under a different name.

PEAS—FIELD.—By the term field pea is sometimes meant the Southern Cow pea, but more often the field varieties of the English pea. The field pea in the latter sense has been to some extent investigated as a forage and soiling crop, and pea meal has been employed in feeding experiments. The Canada pea is recommended (N. Y. State R. 1890, p. 357) as best for forage purposes, and the results of a comparative trial are given in which this variety gave considerably larger yields than garden peas. At the Minnesota Station (B. 11) several field varieties, including Canada, were tested. White and blue Canada peas were also sown with oats in different proportions, with results indicating that three bushels of peas should be sown to one of oats, or, where the oats stool largely, to two-thirds of a bushel. The advantage of this crop in rotation with wheat is presented, and it is believed that the peas will pay when machinery is invented for harvesting and threshing them as good as that provided for wheat.

PHOSPHORIC ACID.—"Phosphorus is, next to nitrogen, the most costly ingredient of fertilizers, in which it always exists in the form of phosphates, usually those of calcium, iron and aluminum, or, in case of some 'superphosphates,' in the form of free phosphoric, acid.

"Soluble phosphoric acid implies phosphoric acid or phosphates that are freely soluble in water. It is the characteristic ingredient of superphosphates, which are produced by acting on 'insoluble' or 'reverted' phosphates with diluted sulphuric acid (oil of vitriol). Once well incorporated with the soil, it gradually becomes reverted phosphoric acid.

"Reverted (reduced or precipitated) phosphoric acid means, strictly, phosphoric acid that was once easily soluble in water, but from chemical change has become insoluble in that liquid. In present usage the term signifies the phosphoric acid (of various phosphates) that is freely taken up by a strong solution of ammonium citrate, which is therefore used in analysis to determine its quantity. 'Reverted phosphoric acid' implies phosphates that are readily assimilated by crops.

"Recent investigation tends to show that soluble and reverted phosphoric acid are, on the whole, about equally valuable as plant food, and of nearly equal commercial value.

"Insoluble phosphoric acid implies various phosphates not soluble in water or ammonium citrate. In some cases the phosphoric acid it too insoluble to be readily available as plant food. This is especially true of the crystallized green Canada apatite. Boneblack, bone ash, South Carolina rock, and Navassa phosphate when in coarse powder are commonly of little repute as fertilizers, though good results are occasionally reported from their use. When very finely pulverized (floats) they more often act well, especially in connection with abundance of decaying vegetable matters. The phosphate of calcium in raw bones is nearly insoluble, because of the animal matter of the bones, which envelops it; but when the latter decays in the soil the phosphate remains in essentially the 'reverted' form. The phosphoric acid of Thomas slag and of Grand Cayman's phosphate is freely taken up by crops.

"Phosphoric acid in all the station analyses is reckoned as 'anhydrous phosphoric acid' (P^2O^5)."

POTASH —"Potassium is the constituent of fertilizers which ranks third in costliness. In plants, soils and fertilizers it exists in the form of various salts, such as chloride (muriate), sulphate, carbonate, nitrate, silicate, etc. Potassium itself is scarcely known except as a chemical curiosity.

"Potash signifies the substance known in chemistry as potassium oxide (K^2O), which is reckoned as the valuable fertilizing ingredient of potashes and potash salts. In these it should be freely soluble in water and is most costly in the form of sulphate, and cheapest in the form of muriate (potassium chloride).

"The extent to which fertilizers are used in the United States is indicated by the fact that most of the Atlantic and Gulf coast states and several of the Western states have found it necessary to pass laws regulating the manufacture and sale of commercial fertilizers. Where the soil has long been under cultivation or where specialized intensive farming is engaged in, commercial manures are very generally used, since they supply in concentrated and convenient form the fertilizing elements required by special crops and soils and furnish a valuable supplement to farm manures. On the deep, rich soils of California, the prairies of the West generally, and on the black slough soils of Alabama the use of fertilizers is, as a rule, unnecessary (Ala. Canebrake B. 3, B. 10, 11, B. 14; Ill. B. 4, B. 8, B. 11, B. 13, B. 15, B. 17, B. 20; Ohio B., Vol. III, 1, 2, 6), but it has already been found that in many cases the California soils need to have their natural resources of plant food supplemented by concentrated fertilizers (Cal. B. 88), and this probably will eventually be true for the others.

"Experiments at the New Jersey Station (B. 85, R. 1891, p. 409) suggested that the various chemicals used in commercial fertilizers may be made a means of destroying numerous insects (cutworms, wireworms, root lice, etc.) infesting the soil. It is advised "whenever possible to apply potash in the form of kainit and nitrogen in the form of nitrate soda, and both as top dressing." Experiments at the New York Cornell Station (B. 33), however, throw doubt on the efficiency of this method as applied to wireworms.

Potatoes.—In seasons when potatoes are as cheap as they were in 1895-96, it will be found profitable to feed them to cows. They tend to produce a large flow of milk of rather inferior quality. For effect of cooking potatoes, see "*Preparation of Foods.*"

Preparation of Foods.—"Under this heading are treated the trials on the effect of cooking, steaming, moistening, chopping, grinding and otherwise preparing food for cattle, sheep and pigs. Experiments abroad have indicated that cooking or steaming coarse or unpalatable food was advantageous, not on account of making the food more nutritious but in inducing the animals to eat large quantities of it. In fact, it has been shown for lupine hay and some other materials that the digestibility of certain of the food ingredients, notably the albuminoids was diminished by steaming; and the cooking of potatoes, which was formerly believed advantageous, has been shown to be of no advantage whatever in case of milch cows, although it was of advantage to pigs. Julius Kühn, in his book on feeding, says: 'Unless large amounts of straw and coarse foods are to be fed and the supply of good hay and hoed crops is scarce, it will usually be more profitable to omit the steaming. If the reverse condition prevails, steaming will be found a very advantageous means of inducing the animals to eat sufficiently large quantities of the food.

"The experiments made by our experiment stations in preparing food have been mostly with pigs.

COOKING AND STEAMING.—"Ladd reported analyses (N. Y. State B. 5, n. ser., R. 1885, p. 315) of cooked and uncooked clover hay and corn meal, and determinations of the digestibility of the same by artificial means. These showed that the percentages of albuminoids and fat and the relative digestibility of the albuminoids were more or less diminished by cooking. A trial with one sheep at the Oregon Station (B. 6) indicated that the digestibility of silage was improved by cooking, but more extended trials are necessary to settle the question. With reference to the value of cooking or steaming food for pigs, at least thirteen separate series of experiments in different parts of this country have been reported. In these cooked or steamed barley meal, corn meal, corn meal and shorts, whole corn, whole corn and shorts, peas, corn and oat meal, potatoes, and a mixture of peas, barley, and rye have been compared with the same foods uncooked (and usually dry). In ten of these trials there has not only been no gain from cooking, but there has been a positive loss, i. e., the amount of food required to produce a pound of gain was larger when the food was cooked than when it was fed raw and in some cases the difference has been considerable. In the three exceptional cases there was either no gain at all or only very slight gain from cooking orsteaming, amounting to 2 per cent. in one case.

"Experiments in feeding steamed cotton seed to cows are reported by the Mississippi Station (B. 15, B. 21, R. 1890, p. 26). The results seemed to be favorable to steaming. See also *Cotton seed and cotton seed meal for milk and butter production.*

ROASTING —An experiment in feeding roasted cotton seed to cows is reported in Miss. B. 15, R. 1891, p. 26.

"MOISTENING AND SOAKING —Three stations have reported comparisons of dry and wet or soaked food for pigs. The food consisted of shelled corn in one case, of a mixture of corn meal and shorts in another, and of a mixture of corn meal, shorts and linseed meal in a third. In every case the pigs ate more of the wet food and made larger gains on it. The additional gain was usualy due to the larger amount of food eaten when moistened or soaked.

Cutting and Chopping Coarse Fodder.—The Maine Station (R. 1890, p. 49) compared the value of chopped and unchopped hay for cows and found no evidence that the chopping had any effect.

"Cutting corn stover was found advantageous at the Wisconsin Station (R. 1884, p. 11).

"The Indiana Station (B. 37) found that steers made better gains on cut than on uncut clover hay. A trial of feeding cut and uncut hay to horses has been reported by the Utah Station (B. 13).

" Grinding.—Four stations have reported experiments on the value of grinding corn for pigs. As a rule these experiments have indicated that grinding does not pay. The Maine Station (R. 1886, p. 59) found that pigs digested a considerably larger percentage of the protein, carbohydrates and fat from ground than from unground corn. One station found ground oats preferable to whole oats for fattening pigs, but not for maintenance of brood sows.

"As between whole and ground corn for steers, the results at two stations have been very favorable to grinding, and at a third station the results in two years were contradictory.

"A trial of feeding whole and ground grain to horses is reported by the Utah Station (B. 9)."

Protein— "(or nitrogenous materials) constitutes the flesh forming materials of the food. It furnishes the materials for the lean flesh, blood, skin, muscles, tendons, nerves, hair, horns, wool, the casein and albumen of milk, etc. For these purposes protein is absolutely indispensable in the food of animals. No substances free from nitrogen can be worked over into protein or fill the place of protein. Under certain conditions it is believed protein may form fat in the body, and finally it may be burned like the carbohydrates and fat, yielding heat and energy.

"The sources of heat and energy, then, are the carbohydrates of the food and the fat and protein of the food or the body for the fat and protein in the body may be burned like those in the food. The fuel value of fat is about two and a half times that of carbohydrates and protein. This sources of fat in the body are the fat, carbohydrates, and probably the protein of the food; and the exclusive source of protein in the body is the protein in the food.

"The composition of feeding stuffs is determined by chemical analysis. A large number of such analyses have been made in this country and these have been compiled and published in Bulletin No. 11 of the Office of Experiment Stations. Such analyses usually give the percentages of water, ash, cellulose (fiber) fat, protein and nitrogen free extract. But only a portion of each of these various ingredients in a feeding stuff is digested.

RUTABAGAS.—This root can often be used to advantage in winter dairying to aid digestion. See *Mangels.*

RYE.—"The experiments with this crop by the stations have been chiefly with reference to its value as a forage plant. At several of the stations in the Southern states it has been found that rye sown in the summer will give an abundant amount of green fodder at three or four cuttings during the fall and winter (Ala. College B. 16, n. ser.; Ala. Canebrake B. 9). At the Vermont Station rye sown in September gave abundant green fodder for cows by the middle of May, but after May the stalks became tough and unpalatable (Vt. R. 1889, p. 87.) Seaweed proved an efficient fertilizer for rye in an experiment at the Rhode Island Station (R. I. R. 1890, p. 13). At the Arkansas Station pea vines plowed under largely increased the yield of rye forage (Ark. B. 18). See also Cal. R. 1890, p. 209, Colo. R. 1889, p. 105, R. 1890, p. 284; Nebr. B. 15, B. 19; Pa. B. 5 (1888), B. 15 (1886); S. Dak. B. 21.

SILAGE.—(*See Corn Silage.*)

SKIM MILK.— "A short comparison of whole milk and separator skim milk at the Mississippi Station (R. 1888, p. 43) was favorable to the latter. The calves receiving ten pounds of skim milk made nearly as large gains as those receiving eight pounds of whole milk. Whole milk and skim milk from deep setting were also compared at the Iowa Station (B. 14), one and one-half pounds of flaxseed meal per day being added to the skim milk ration. The lot on whole milk made the largest gain in ninety-one days, but the result is regarded as very favorable to the skim milk ration, for the calves on that ration appeared in the best condition and were fed more cheaply. Estimating the whole milk at eighty-seven and one-half cents and skim milk at fifteen cents per 100 pounds, flaxseed meal at three and one-half cents per pound, etc., the cost of food per pound of gain was 7.6 cents for the whole milk lot and five cents for the skim milk lot. The above trial included a Shorthorn and a Holstein in each lot. The Holsteins in each case made the larger gain in weight.

"Two calves fed together on skim milk, linseed meal and ground oats, at the Wisconsin Station (R. 1883, p. 37) averaged one pound of growth for thirteen pounds of milk, one-half pound of linseed meal and one-third pound of oats. The same station noticed that the skim milk from centrifugal creameries was often thrown away because it soured to rapidly and made experiments bearing on the value of curdled skim milk (Wis. R. 1886, p. 21). Skim milk was curdled by heating with liquid rennet and the whey was poured off. The curd with the whey remaining with it constituted about sixty per cent. by weight of the whole. In two trials calves were fed on this curd a month and then for a month following on sweet skim milk. The gains were nearly as large on the curd as on skim milk, and larger amounts of grain were eaten with the skim milk.

"A trial of raising scrub stock at the New York State Station (R. 1890, p. 359) brought out the undesirability of feeding late maturing animals or those which do not consume food enough to make a profitable growth.

"In a trial of fattening a large number of calves on various foods the Mississippi Station (B. 8) observed that the grade Jerseys increased in weight more rapidly than the grade Holsteins. (Mo. College B. 27; N. Y. State R. 1887, p. 23; Pa. B. 17.)"

"PIGS, SKIM MILK AS FOOD.—Skim milk, as the station experiments have shown, forms one of the best and most economical bases for a ration for growing pigs. Although corn is the food by far the most extensively used for pigs, it produces excessively fat pork when fed alone. Skim milk has the very great advantage of being a nitrogenous food. Fed in connection with corn meal it produces a leaner pork, usually at a lower cost, which commands a higher price than very fat pork. The Massachusetts State Station keeps a pig for every milch cow to drink the skim milk.

"Experiments in which skim milk has been used have been in progress at the Massachusetts State Station since 1884 (R. 1884, p. 68, R. 1885, p. 23, R. 1887, p. 55, R. 1888, p. 55, R. 1889, p. 103). In these experiments two conditions have been considered, (1) a large supply of skim milk, and (2) a limited one. In considering the first condition the plan has been to mix corn meal with the skim milk in the following proportions:

Live weight of animal.	Corn meal per quart of milk.
Pounds.	*Ounces.*
20 to 70	2
70 to 130	4
130 to 200	6

"Where the supply of skim milk has been limited, the milk has been supplemented by the following grain mixtures extended with water:

Live weight of animal.	Grain mixture (parts by weight.)		
	Gluten meal.	Wheat bran.	Corn meal.
Pounds.			
20 to 70	2	1	. . . . .
70 to 130	1	1	1
130 to 200	1	1	2

The aim has been under both conditions to feed rations having the following nutritive ratios: With pigs weighing from 20 to 70 pounds, 1:2.8 to 1:3; with those weighing from 70 to 130 pounds, 1:3.6 to 1:4; and with those weighing from 130 to 200 pounds, 1:4.5 to 1:5. The pigs were fed all they would eat up clean.

As a result of these experiments the following statements are made:

"(1) Begin as early as practicable, with a well-regulated system of feeding. During the moderate season begin when the animals have reached from 18 to 20 pounds in live weight; in the colder seasons, when they weigh from 25 to 30 pounds.

"(2) The food for young pigs during their earlier stages of growth ought to be somewhat bulky, to promote the extension of their digestive organs and to make them thereafter good eaters. A liberal supply of skim milk or buttermilk, with a periodical increase of corn meal, beginning with two ounces of corn meal per quart of milk, has given us highly satisfactory results.

"(3) Change the character of the diet at certain stages of growth from a rich nitrogenous diet to that of a wider ratio. * * * Begin, for instance, with 2 ounces of corn meal to 1 quart of skim milk; when the animal has reached from 60 to 70 pounds, use 4 ounces per quart, and feed 6 ounces of meal per quart after its live weight amounts to from 120 to 130 pounds."

"The Wisconsin Station found (R. 1883, p. 33) that when skim milk and corn meal were each fed ad libitum to separate lots of pigs, the pigs on skim milk made somewhat the larger gain. To produce a pound of gain, 4 pounds of corn meal or 19 pounds of skim milk were consumed. When the two were mixed the indications were that "much corn meal should be fed with the skim milk, since the meal furnishes largely carbohydrates and the skim milk largely protein." The greatest gain for the food eaten occurred when 2 pounds of meal was fed with 3⅓ pounds of skim milk.

"At the Maine Station (R. 1889, p. 103) when skim milk was substituted for a part of the corn meal without changing the amount of digestible food eaten, the ration was more efficient, but there was a limit to this replacement. For instance, a ration, one-third of whose nutrients was furnished by skim milk, proved to be practically as efficient as one in which two-thirds of the nutrients were from skim milk. Pigs fed all they would eat of a mixture of 1 pound of corn meal and 3 pounds of skim milk made an average gain in 55 days of 83 pounds, requiring 9.51 pounds of skim milk and 3.17 pounds of corn meal per pound of gain (Wis. R. 1888, p. 93). Another trial (Wis. R. 1888, p. 96) indicated "that to produce pork rapidly a large proportion of skim milk to corn meal may be fed, but that such feeding is not the most economical, and that a pound or a pound and a half of skim milk to 1 pound of corn meal is as much as can profitably be fed when skim milk is valued at 20 to 25 cents and corn meal at 75 cents per 100 pounds." Pigs weighing 400 pounds each and others weighing 140 pounds were given all they would drink of skim milk, with a little corn meal stirred into it, for 63 days (Wis. R. 1889, p. 24). The lighter pigs ate much less per pound of gain than the mature ones.

"Experiments at the Vermont Station (B. 18) also brought out the value of skim milk for growing pigs. It is calculated that with pork at 5¼ cents per pound, dressed weight, there was received for the skim milk fed, on an average, 24 cents per 100 pounds, or 2.13 cents per gallon.

"Other authorities have stated that with proper feeding 200 pounds of skim milk is equivalent to a bushel of corn.

"The New Hampshire Station (B. 11) compared a mixture of two parts, by weight, of skim milk and one part of corn meal with a mixture of equal parts of wheat middlings and corn meal for 133 days. The two rations contained like amounts of total digestible food, and were fed so as to furnish 0.53 to 0.54 pound of protein and 3.33 to 3.36 pounds of carbohydrates and fat per 100 pounds, live weight, per day. "The rate of gain was unmistakably greater on the skim milk and corn meal than on grain alone, while the cost of growth [with skim milk at 25 cents per 100 pounds and corn meal at $20 and middlings at $26 per ton] was from 1.2 to 1.19 cents greater per pound when the food was mixed grain. On grain alone there was a loss of more than 1 cent for every pound of growth. * * * With thrifty pigs, from 20 to 30 cents per hundred can be realized for skim milk when live hogs sell at 4 cents per pound. It must be constantly kept in mind, however, that they must be sold by the time they reach 200 to 230 pounds, live weight." The average cost of food per pound of gain, at the above prices, was 3.6 cents on skim milk and corn meal and 5.2 cents on the mixed grain.

"SKIM MILK VS. BUTTERMILK.—These were compared in two series of experiments at the Massachusetts State Station (R. 1884, p. 68, R. 1885, p. 23), feeding corn meal with each. The skim milk contained a fifth more solids than the buttermilk; but in spite of this in the first trial when they were fed in equal quantities there was little if any, difference in the gain in weight, and for the amount of dry matter eaten the buttermilk proved most nutritious, for on the buttermilk ration 2.4 pounds and on the skim milk ration 2.9 pounds of dry matter were eaten per pound of dressed pork.

"In the second experiment the two rations were adjusted so as to furnish like amounts of dry matter instead of like quantities of milk and corn meal. The result was then better on the skim milk ration than on the other. With buttermilk at 1.37 cents and skim milk at 1.8 cents per gallon, the buttermilk was somewhat the cheaper; at the same price per gallon the skim milk would have been the cheaper.

"The Wisconsin Station (R. 1886, p. 24) compared skim milk with buttermilk, feeding each in like amount and mixed with corn meal. The pigs on skim milk made a slightly larger gain than the others. With pigs at 5 cents per pound and corn meal and shorts at $15 per ton, "the skim milk would have a value of 35 cents and the buttermilk 28 cents per 100 pounds."

"PIGS, WHEY AS FOOD.—The Wisconsin Station (B. 27, R. 1891, p. 38) reports four trials in feeding whey. "We were not successful in maintaining pigs on whey alone. * * * Added to a corn meal and shorts mixture it produced a marked saving in the grain required for good gains. * * * If corn meal and shorts are valued at $12 per ton, then whey is worth 8 cents per 100 pounds; at $15 per ton for the corn meal and shorts whey would be worth 10 cents per 100 pounds.

TIMOTHY HAY.—As a rule, the timothy hay had better be sold and some nitrogenous by-product bought in its stead. Its feeding and fertilizing value is not as high as that of clover hay, but will bring more on the market. (See tables showing *percentage composition* and *fertilizer constituents* of American feeding stuffs.

WIDE RATION.—By this is meant a ration in which the nutritive ratio is wide. For instance, a ration with a nutritive ratio of 1:12 would be called a wide ration.

WATER IN FOODS.—However dry a feeding stuff may appear to be whether hay, coarse fodder, grain or meal, it always contains a considerable amount of water, which is invisible and imperceptible to the senses, but which can be driven out by heat. This water is probably of no more benefit to the animal than water which it drinks and from which the chief supply is derived. As the amount of water in a food is a useless bulk, comparisons of different kinds of foods are usually made on a dry or water free basis, which shows the percentage of ash and food ingredients in the dry matter.

WHEAT BRAN.—For value as a feeding stuff see accounts of experiments under *gluten meal, cotton seed meal*, and *effect of food upon milk.*

WHEAT GRAIN GROUND.—Until within the few past years, there was practically no wheat fed to dairy cattle. The few experiments that have been made appear to be favorable to it as a milk producing food. It, therefore, depends upon the price as to whether or not it can be fed profitably to dairy cattle.

Wheat Middlings.—It contains about 25 per cent. more digestible matter than wheat bran, but the nutritive ratio is not as narrow (see feeding tables). Where the two materials are selling at the same price, as they do in some sections, the middlings had better be bought in preference to bran.

Wheat Shorts.—The composition of wheat shorts is practically the same as that of wheat middlings, and could often be used to advantage as a food for dairy cows.

Wheat Straw.—The feeding value of wheat straw is not very high, but when coarse fodder is scarce a small amount can often be fed to good advantage.

Whey.—*See Skim Milk.*